NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

INFORMATION SYSTEMS PLANNING METHODOLOGIES:

A FRAMEWORK FOR COMPARISON AND SELECTION

by

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September, 1991

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b. OFFICE SYMBOL (*If applicable*) 55	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c. ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000	7b ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (*If applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*City, State, and ZIP Code*)	10. SOURCE OF FUNDING NUMBERS Program Element No. / Project No. / Task No. / Work Unit Accession Number

11. TITLE (*Include Security Classification*)
INFORMATION SYSTEMS PLANNING METHODOLOGIES: A FRAMEWORK FOR COMPARISON AND SELECTION

12. PERSONAL AUTHOR(S) Steffensen, Robert E.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (*year, month, day*)	15. PAGE COUNT
Master's Thesis	From To	SEPTEMBER, 1991	130

16. SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17. COSATI CODES			18. SUBJECT TERMS (*continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUBGROUP	Planning Frameworks, Strategic Planning, Integrated Planning, Information Requirements, Syntheis of Planning Methodologies

19. ABSTRACT (*continue on reverse if necessary and identify by block number*)

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Acknowledging the importance of comprehensive planning in the process of managing the organization's information resource, a collection of methodologies has been accumulated, to serve in carrying out the IS planning effort. However, a managerial problem that often arises is how to make best use of current planning methodologies. The purpose of this thesis is to survey the existing methodologies, establish a framework for analyzing the IS planning methodologies, and examine some of their advantages and limitations.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION	
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS REPORT ☐ DTIC USERS	Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Moshe Zviran	22b. TELEPHONE (*Include Area code*) 408-646-2174	22c. OFFICE SYMBOL AS/zv

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

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Information Systems Planning Methodologies:
A Framework For Comparison and Selection

by

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

ABSTRACT

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Acknowledging the importance of comprehensive planning in the process of managing the organization's information resource, a collection of methodologies has been accumulated, to serve in carrying out the IS planning effort. However, a managerial problem that often arises is how to make best use of current planning methodologies. The purpose of this thesis is to survey the existing methodologies, establish a framework for analyzing the IS planning methodologies, and examine some of their advantages and limitations.

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I. INTRODUCTION

Planning, according to Anthony (1988), is "a process of deciding on the goals of an organization and the strategies for attaining these goals." Thus, the planning process determines where an organization is going and how it is going to get there. Effective planning is one of the basics of good management. Information systems (IS) are widely accepted as an important organizational resource. As with other resources within an organization (e.g., land, labor, and capital) IS needs to be planned to ensure effective and efficient utilization.

Information has been increasingly recognized as one of the fundamental economic resources, joining land, labor, and capital. Sound IS planning is essential as errors of omission or commission may be very costly. In planning for IS, top management must have a clear view of the economics of information, recognizing the value and cost of information and information systems. Information provides value through lower production costs, increased revenues, and better decision-making. It costs money in the form of hardware, software, personnel, space and supplies. A goal of IS planning should be to produce and maintain information systems that provide the best overall balance between value and cost. (Emery, 1987)

The importance of planning, as with any other organizational function, has long been recognized. Blumenthal (1969) noted the need for IS planning and documented its benefits. In a survey of IS executives, Brancheau and Wetherbe (1987) found that IS

planning was the key issue facing IS professionals. IS planning is critical to the success of any organization heavily dependant on information and is extremely difficult due to its complexity.

Essential to successful IS planning is the selection of one or more IS planning methodologies[1] that will assist IS planners in their mission. An increasing number of IS planning methodologies have been proffered in recent years. This has generated confusion, not only concerning which methodology to use, but also what methodologies are being offered. The selection of a methodology with which to conduct the planning process is one of the initial problems confronting an IS professional when he/she considers an organizational IS plan.

A wide variety of planning methodologies are described in IS literature. Some are well known and frequently used; others are more obscure and less popular. Many of these methodologies were designed specifically for IS planning, while others were adapted to IS applications from planning activities in other areas.

This thesis will answer two principal questions:

- What are the available IS planning methodologies?
- How does an IS professional select a suitable methodology that will fit the needs of his staff and organization?

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[1] This paper will extensively use the term *methodology* as a generic term that refers to any combination of methods, methodologies, approaches or techniques used for IS planning.

The following chapters describe the IS planning process and review the known IS planning methodologies with the focus of concentration on the characteristics, features, advantages and limitations of each methodology. The methodologies will be classified within the Basic Three Stage Model of IS Planning (Bowman, et al., 1983) and applied to a framework for evaluation and comparison of their individual attributes. Conclusions and recommendations for application of the methodologies to various IS planning needs will also be offered.

II. THE INFORMATION SYSTEMS PLANNING PROCESS

A. GENERAL

Planning is the basic process by which organizations establish their goals for the future and their strategy for achieving them. Managers must make plans that give purpose and direction to an organization, deciding what needs to be done, as well as when and how it needs to be done and who is to do it. Successful managers at all levels and in all organizational functions plan. Some do it formally, while others carry out this mission in a less formal manner. Davis and Olson (1985) suggest that planning should be a continuous activity that provides a framework for operational activities and decision making. An organizational hierarchy of planning activities serves as a basis for the transformation of the mission, or purpose, of an organization into operational goals and objectives. Most organizations plan, though not all accomplish it formally. For those who plan informally, planning is usually inconsistent and incomplete. A few reasons for formal organizational planning are:

- to focus the energies and activities of an organization on achievement of its objectives.
- to reconcile differences in objectives and plans of subareas and individuals within an organization.
- to remove ambiguities about what an organization should do. (Davis and Olson, 1985)

Formal plans not only guide organizational activities, but also serve as a means for evaluating results. The planning process can be motivating for both individual and organizational achievement. Plans reflect the hopes and desires of an organization concerning the environment, the capabilities of an organization, and decisions concerning allocation of resources and direction of effort.

Information Systems planning is the process of determining and analyzing information requirements and integrating those requirements with overall organizational objectives. McFarlan (1971), McLean and Soden (1977), Ward, et al. (1990), and others have identified not only the need but the necessity for an effective IS plan. An IS plan provides an opportunity for an organization to exploit rapidly advancing information technology. An IS plan must take into account both the short and the long term views in order to properly allocate resources as well as support the information needs of an organization (Emery, (1987).

Organizations are often pressured into IS planning. The critical pressures that force an organization to plan ahead remain valid and are increasingly important today (McFarlan and McKenney, 1983). These include:

- Rapid changes in information technology.
- Scarcity of experienced information systems professionals.
- Scarcity of organizational resources.
- Organizational dependence on information systems support.

Those organizations that plan, generally do so with specific objectives in mind. Examples of specific objects include the need to integrate or link the IS plan and the overall organizational plan (McLean and Soden, 1977); the use of IS as a competitive weapon (Ives and Learmonth 1984); improved budgeting and resourcing (Ward, et al., 1990); or various other objectives.

B. LEVELS OF IS PLANNING ACTIVITIES

A hierarchial application portfolio model for IS planning in organizations was defined by Anthony (1965). This model described an information planning and control structure with three levels:

- strategic planning
- management control
- operational control

Davis and Olson (1985) conceptualized a hierarchy of planning across four levels. The top three levels corresponded to Anthony's model, with an additional level of scheduling and planning. Their definitions of the different organizational levels of responsibility, the scope of planning issues addressed, and Hirshfield's (1983) planning horizons are shown in Table 1.

TABLE 1. HIERARCHY OF PLANNING. (DAVIS AND OLSON, 1985).

Level of Planning	Anthony's Framework	Definition
Strategic Planning	Same	What function will the organization serve and what will it be like in the future? (Five years and beyond.) Strategic plan should include business to be in, market it should sell to, etc.
Tactical Planning	Management Control	Physical implementation of strategic plans. (One to five years.) Reflected in capital expenditure budget and long-range staffing plan.
Operations Planning	Operational Control	Allocation of tasks to each organizational unit in order to achieve objectives of tactical plan. (One to twelve months.) Yearly budget.
Scheduling and Dispatching	_____	Assign specific units of organizational activity to achieve operational objectives. (Immediately.)

Bowman, et.al. (1983) determined three basic generic planning activities based on Anthony's (1965) model: strategic planning, organizational information requirements analysis (tactical planning), and resource allocation (operational planning). They gave the following definitions of the IS planning activities:

- **Strategic IS planning:** establishing the relationship between the overall organizational plan and the IS plan.
- **Organizational information requirements analysis:** identifying broad, organizational information requirements to establish a strategic information architecture that can be used to direct specific application system development project.

- **Resource allocation:** allocating both IS application development resources and operational resources. (Bowman, et al., 1983)

1. Strategic Planning

Information systems planning initiates with a strategic plan that will provide a framework from which succeeding plans can be developed. The succeeding plans, organizational information requirements analysis and resource allocation, will clarify and provide the details for the strategic plan. It is in the strategic planning stage that the present and future information needs of the overall organization are determined. The organization's specific IS and overall missions, objectives, policies and strategies are determined at this level. One of the principal goals of strategic IS planning is the integration of information systems with organizational objectives. Strategic planning should also take into account an organization's external and internal environments. It should recognize information as a key resource and be subsequently managed as such. The organization's strategic plan must form the foundation of the IS strategic plan to achieve total integration of business and information. (Ahituv and Neumann, 1990)

McLean and Soden (1977) offered the following generic steps involved in the strategic planning stage:

- Set the IS mission or charter.
- Formally assess the organizational environment to identify IS opportunities, threats and risks.
- Establish IS objectives defining the desired results to be achieved, and relate them to the strategic objectives of the overall organization.

- Develop IS strategies, consisting of broad courses of action, describing how the previously set objectives are to be achieved.

- Define IS policies as guidelines to be used in carrying out strategy, giving particular emphasis on policies relating to: organization of the IS effort; allocating scarce resources; and establishing expenditure levels.

Strategic planning will likely occur at infrequent intervals and usually is accomplished as a result of a need to resolve organizational issues that involve the IS function. Accordingly, the establishment of a strategic IS plan is the responsibility of top management. (McLean and Soden, 1977)

2. Organizational Informational Requirements Analysis

The organizational informational requirements analysis level is generally divided into two phases:

- **Long-range plans:** which assesses current and projected information needs to support decision making and operations of organizations.

- **Medium-range plans:** from which master development plans are assembled. (Ahituv and Neumann, 1990)

The overall information systems architecture, consisting of a description of general courses of action and broad resources required to execute the strategies, is developed through a long-range plan. An IBM (1976) publication recommended a generic methodology for developing a long-range plan, which consists of three steps:

- Collecting background information: strategic organizational objectives for IS; characteristics of future hardware and software technology; characteristics of future use of human resources; potential external pressures for change; portfolio of information services foreseen by users for the next five to ten years; current major

problem areas from the IS management point of view and from the user management point of view.

- Analyzing overall resource needs: demand for resources can be established in terms of type, capability, quantity, and timing. This demand is then compared with currently available resources in order to determine whether these resources together will be capable of meeting demands.

- Developing the long-range document: Specify objectives, and project future trends; resource plans, organizational effects, scope and structure of the IS function and potential risks and opportunities. (IBM, 1976)

The master plan, often referred to as the medium-range plan, is the detailed plan for developing an information system necessary to meet the present information needs of an organization. The focus of a master plan is managerial; it contains a portfolio of prioritized projects to be implemented. The projects will provide for hardware and software procurement, budgeting and staffing of multi-year projects, and development activities. Every organization involved in development and maintenance of IS must have a master plan. Ahituv and Neumann (1990) contend that an IS master planning document should include:

- Objectives and general strategy: a restatement of organizational long-range and medium-range objectives, strategies, and priorities, combined with a statement of the overall objectives for the information system and the IS unit.

- Current IS situation: current systems in operation and in development, and level of resources used by each; hardware and software, including levels and costs; organization and staffing, including skill level and type and costs; and facilities utilization.

- Expenditure plan: projected IS expenditures, annually for the next five years, in absolute terms by resource group, and in relative terms as a percentage of an organization's total sales.

- Support plan: hardware and software requirements for the chosen planning period and the personnel needed to meet these requirements.

- Operations plan: major characteristics of IS operations projected over the chosen planning period and the resources needed for production and support of development projects.

- Staffing and organization plan: total personnel requirements for a planning period by major type of activity.

- Application development plan: new or revised application that will be developed or acquired over the next five years, including time schedules and expenditures for each application. This should as a minimum include: project priority ranking; development timetable for project portfolio; specific project descriptions; specific development cost estimates; specific operating cost estimates; specific project benefits estimates; and specific project risk evaluations. (Ahituv and Neumann, 1990)

The IS master plan should be a closely coordinated endeavor with full participation of top management, the IS function, the users, and any standing or ad hoc IS committees.

3. Resource Allocation

The resource allocation level of IS planning was referred to as a short-range, annual or operational plan by Ahituv and Neumann (1990). Resource allocation planning concerns the performance targets and specific tasks, schedules, and budgets to achieve short-range objectives, usually of one year or not more than two years in duration. Projects that will enhance and maintain an existing system are incorporated into planning at this level. Normally the IS function of an organization is the principle involved with the formulation of a resource allocation plan. However, extensive involvement of users is also desirable, particularly in the initial phase of planning. Given the degree of volatility in the IS arena, it is desirable to have continuous user involvement throughout

the year. The final product of the resource allocation phase should be an IS budget and operating plan. These plans will delineate activities for a period, as well as resources required to accomplish them. (Ahituv and Neumann, 1990)

The following is suggested as a generic format (IBM, 1976) for a resource allocation plan:

- **Service objectives and overview**: assumptions on which a plan is based and the objectives of an IS function for a period. It should also summarize key elements of a plan to include overall resources needed, total expenditures, and major acquisitions of hardware and software.

- **Application development and maintenance plan**: includes a description of all applications to be implemented during the year and the resources required for maintenance of existing applications.

- **Operations plan**: a description of the work load by major application of all work areas of operations functions, such as, data entry, computing, output quality control, data storage, and data transmission. Includes the resources required to handle the work load.

- **Technical support plan**: a description of the activities and resources needed to give technical support to the activities of application development, maintenance, and operations. The plan may be subdivided into plans covering computer performance evaluation, installation of equipment during the year, installation of systems software, database administration, communications network administration, systems coordination, and miscellaneous technical assistance to users and staff.

- **Standard practices program**: a statement of key dates and resources needed for the implementation of standard practices (e.g. design, programming, data, security, and auditing standards).

- **Staffing and organization plan**: any major changes in the organizational structure of an IS function considered necessary for future activities. It summarizes the total demand for personnel, by category, for each organizational unit, project, and activity. It also outlines a plan of action to acquire needed resources.

- **Education and training plan**: outlines a plan of action for developing necessary skills of new employees and existing personnel.

- **Site plan**: gross plan for the accommodation of new resources (equipment and personnel). The plan states the needs, key dates, resources required, and other matters of particular importance.

- **Financial plan**: Shows the cost and revenues associated with all activities (outlined in steps 1 to 8) during the year. The financial plan covers the operation budget, expressed in terms of costs and expenses distributed among projects and organizational units. Any expected revenues should, be stated. If costs are charged to ultimate users, the operating budget has to outline expected distribution to those users. The capital budget is also a part of the financial plan and should state the projected expenses for requisition of fixed assets, such as machinery, equipment, furniture, and sites. (IBM, 1976)

The three levels of IS planning are designed to generate objectives, strategies, and policies for an organization. As an organization conducts planning down through each level, additional resources are committed to information systems. Conservation of resources is a principal reason for the development of an IS plan through each succeeding level. The strategic plan is the responsibility of top management and the IS function is responsible for completing the operational requirements analysis and the resource allocation plans in accordance with the strategic plan. (Ahituv and Neumann, 1990)

C. INFORMATION SYSTEMS PLANNING METHODOLOGIES

Davis (1982) defined a methodology as an orderly or systematic procedure.[2] An IS planning methodology provides a set of methods and techniques, often referred to as a framework, with which to conduct a formal planning process.

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[2] Davis noted that the terms method and methodology are often used interchangeably.

A wide variety of IS planning methodologies are described in IS literature. Many of the methodologies were designed specifically for IS planning, while others were adapted to IS applications from planning activities in other areas. Each of the methodologies seeks to determine the what, when, and how to do the right things, but their vast differences in scope and application have created much more confusion than clarity. Many of the methodologies compete in the IS market place. However, their coverage of the planning levels and their characteristics vary greatly. (Bowman, et al. 1983) (Wetherbe, 1988) and (Zviran, et al., 1989)

Two examples of commonly cited yet differing IS planning methodologies are Business Systems Planning (BSP) (IBM, 1984) and Critical Success Factors (CSF) (Rockart, 1979). BSP concentrates on automating existing processes within an organization, while CSF analyzes information needs based on key areas which are critical to an organization's survival and growth.

Wetherbe (1988) and others have noted the lack of a comprehensive framework for classification of the methodologies and comparison of their characteristics. Given the importance of an IS plan to exploit the information resource, a framework for comparison and selection of IS planning methodologies would be of considerable value to an IS planner.

III. FRAMEWORKS FOR EVALUATING IS PLANNING METHODOLOGIES

A. THE THREE STAGE MODEL

Bowman, et al. (1983) identified four problematic IS processes. These problems provide the primary impetus for implementing an IS planning methodology:

- Alignment of the IS plan with the overall strategies and objectives of the organization.
- Design of an IS structure or architecture for the organization as a framework within which applications are to be designed and developed.
- Allocation of IS development and operations resources among competing applications.
- Selection and use of methodologies for performing the first three processes. (Bowman, et al., 1983)

Lacking an adequate model with which to research, explain and apply the plethora of IS planning methodologies, the authors propose the three stage model, as shown in Figure 1. This basic model provides a generic framework of the three recognized levels of IS

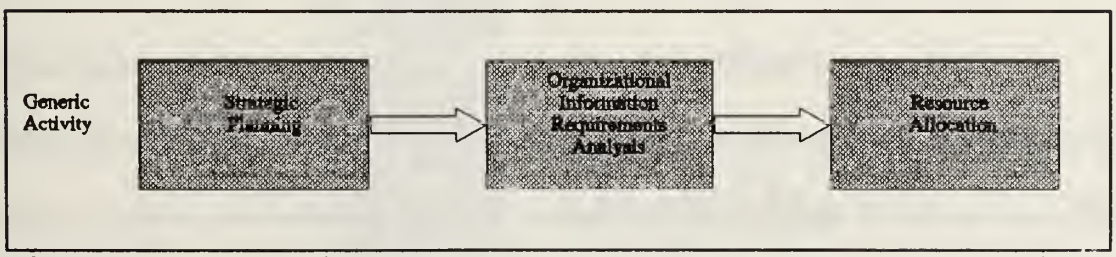

Figure 1. Basic Three-Stage Model of IS Planning. (Bowman, et al., 1983).

planning. The framework aides in the study and evaluation of the IS planning process and provides a means for mapping existing IS planning methodologies to the basic planning levels.

The very general three stage model can be expanded to show the major activities and the outputs of each basic activity as depicted in Figure 2. This detailed figure is intended to move the three stage model from a high level of abstraction to a more concrete formulation of IS planning activities. The three stage model provides insight into the planning process and reduces confusion as to the position of competing planning methodologies. Bowman, et al. (1983) described the three stages as follows:

1. Strategic IS Planning

During the *strategic IS planning* stage, it is crucial to link IS strategy with overall organizational planning. To achieve this the organization must:

- Assess organizational objectives and strategies.
- Set IS mission.
- Assess environment.
- Set IS policies, objectives, and strategies. (Bowman, et al., 1983)

This process should yield an accurate understanding of the strategic purpose and direction of the organization; a new or revised IS charter or mission; an assessment of the state of the IS function; and a statement of policies, objectives, and strategies for the IS planning effort. (Bowman, et al. (1983)

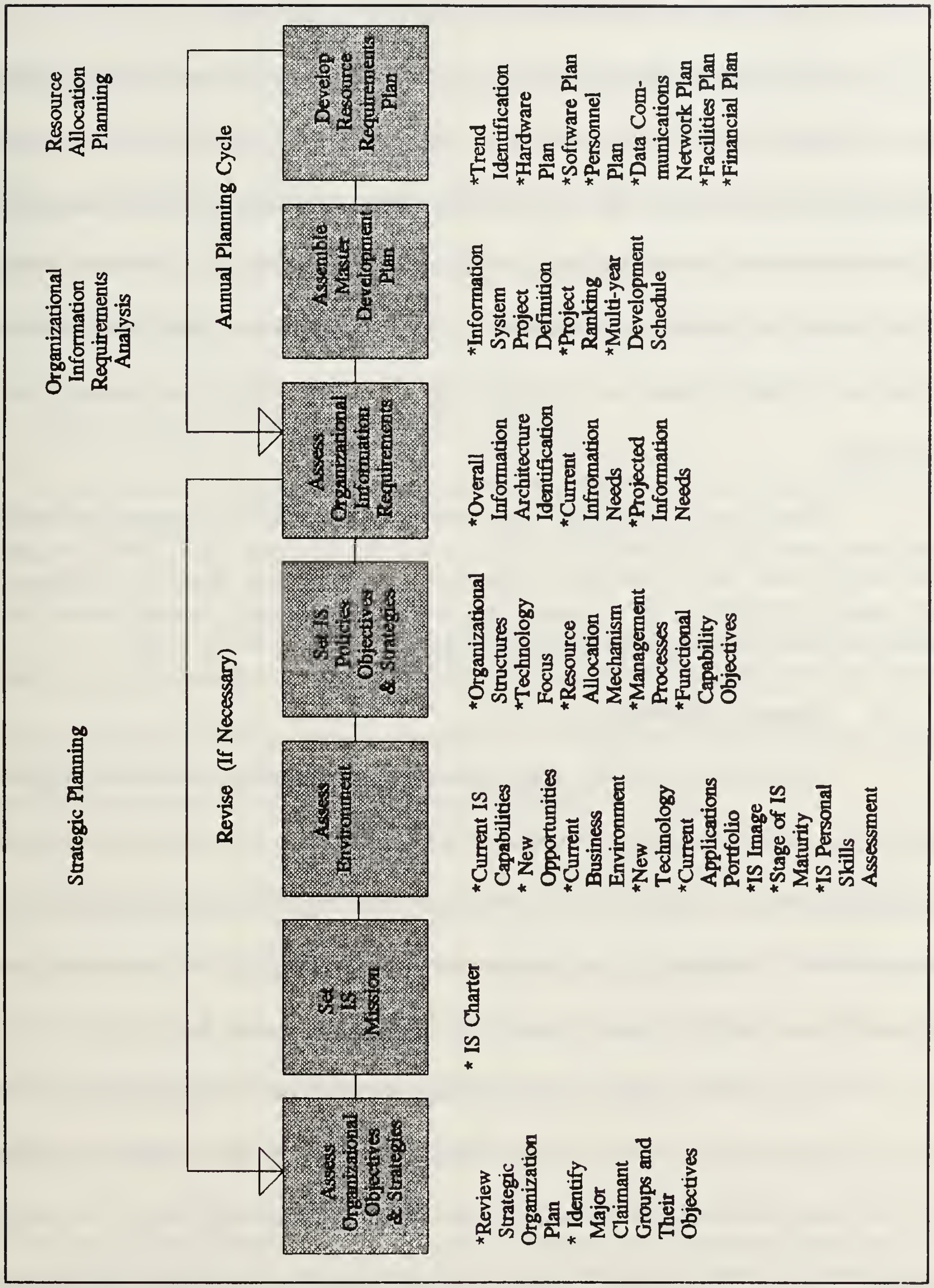

Figure 2. Major Activities and Outputs in Three Stages of IS Planning. (Bowman, et al., 1983).

2. Organizational Information Requirements Analysis

Phase one of the *organizational information requirements analysis* (OIRA) stage consists of assessing current and anticipated information needs to support organizational decision making and operations. These information needs should not be with the detailed information requirements analysis associated with report and terminal display layouts in application system specifications. Rather, it is a high level information requirements analysis aimed at generating an overall information architecture for an organization.

Phase two of the OIRA stage consists of assembling a master development plan derived from the information architecture. It delineates specific IS projects, a ranking of projects, and a development schedule. (Bowman, et al., 1983)

3. Resource Allocation

The *resource allocation* stage includes the development of hardware, software, data communications, facilities, personnel, and financial plans needed to effect the master development plan as defined in the OIRA stage. This stage produces the framework for the acquisition of technology, the planned use of personnel, and the financial resources to provide users with the appropriate level of service. (Bowman, et al., 1983)

As shown in Figure 2, IS planning activities have a sequential flow from "assess organizational objectives and strategies" to "develop resource requirements plan." It is not necessary to execute the entire model during one planning interval. An annual planning cycle may be as concise as assessing organizational information requirements, assembling a master plan, and developing a resource allocation plan. The time involved

in executing an entire cycle may be several years, and will be a function of how rapidly an organization's business objectives and strategies are impacting on the IS requirements.

Bowman's original description of the three stage model included the review and fitting of eight methodologies into the framework. This paper will further pursue the fitting of additional methodologies to provide a comprehensive and updated look at the available planning methodologies and their coverage of the IS planning stages.

B. THE FOURTH STAGE OF IS PLANNING

A fourth stage of IS planning was added to the three stage model by Dickson and Wetherbe (1984). This stage was referred to as *project planning*, and includes developing a plan that expresses schedules and resource requirements for specific IS projects. The project planning stage focuses on evaluating projects, identifying tasks, developing cost and time estimates, and providing check points and completion dates. Milestone, Gantt, and PERT are examples of project planning methods.

C. ENTERPRISE-WIDE INFORMATION MANAGEMENT FRAMEWORK

Benson, et al. (1985) proposed a framework for Enterprise-wide Information Management (EwIM) that was refined by Parker and Benson (1986). The EwIM model described the relationship between the organization, its business strategy, its IS plan, and information technologies. They defined EwIM as:

> Planning, organization, implementation, and control of information resources to meet current and future strategic goals. It results in the alignment of information technology with the enterprise plans, and the alteration of the enterprise goals through the use of information technology.

This relationship is displayed in Figure 3. EwIM was designed to provide a framework for understanding the concepts, the aspects, and effective planning and management in the use of information technology in the organization. The key to this framework is understanding that business and technology planning should be linked, and that business planning should drive the technology planning.

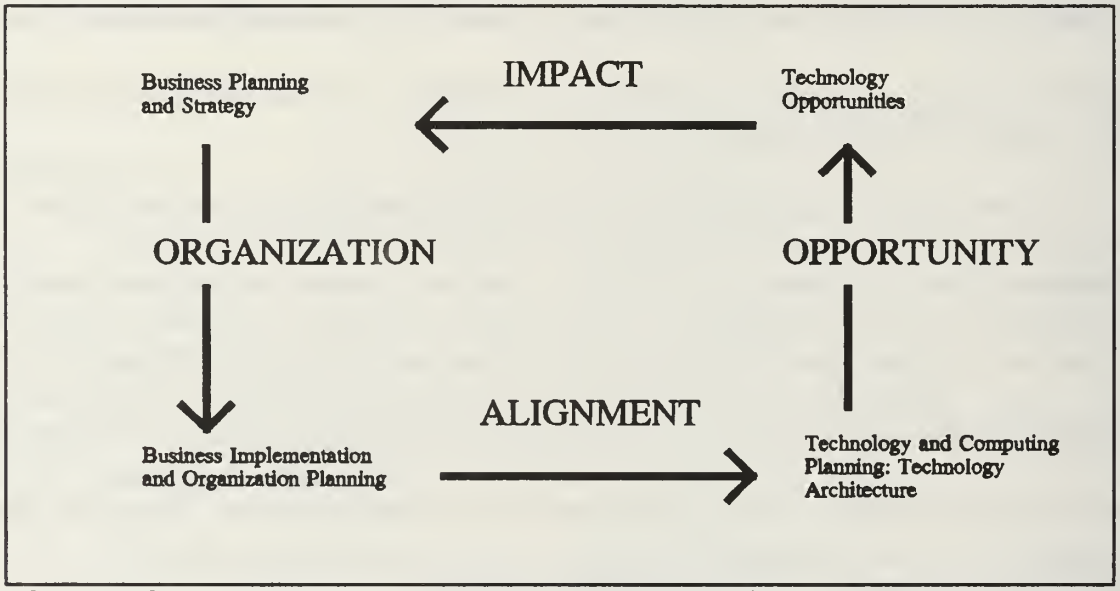

Figure 3. EwIM Planning Relationships. (Parker and Benson, 1986).

The EwIM framework mapped 38 methodologies and techniques for IS and organizational planning into four categories:

- **Alignment:** Internal change or issues concerning the current environment.
- **Impact:** External change or how the organization deals with its customers.
- **Opportunity:** Looks for favorable or advantages circumstances.
- **Organization:** Concentrates on effective and efficient business processes.

D. A FRAMEWORK FOR COMPARING INFORMATION ENGINEERING METHODS

Hackathorn and Karimi (1988) offered a framework (Figure 4) for comparing methods, mapping 26 information engineering (IE) methodologies and tools, according to their breadth and depth.

The *breadth* dimension forms the horizonal axis and deals with strategic information management and the tactical and operational details of the IS. This dimension attempts to describe what is being done and what the result will be. The breadth dimension has five phases consisting of:

- **organizational analysis:** examines the mission and nature of an organization with respect to its environment, as well as producing a formal statement of goals, objectives, and strategies.
- **strategy-to-requirement transformation:** models the IS architecture (including data, application, and geographic) by representing the information flow of an entire organization.
- **logical systems design:** designs the data, application, and geographic architectures, by use of the logical design model.
- **logical-to-physical transformation:** decomposes the data, application and geographic architectures, formulating a portfolio of applications.
- **systems implementation:** implements each subsystem as planned, resulting in an operational subsystem that supports a business function of the organization.

The *depth* dimension focuses on tools for performing the method and deals with the issues of useability and efficiency. This dimension allows an analysis of IE

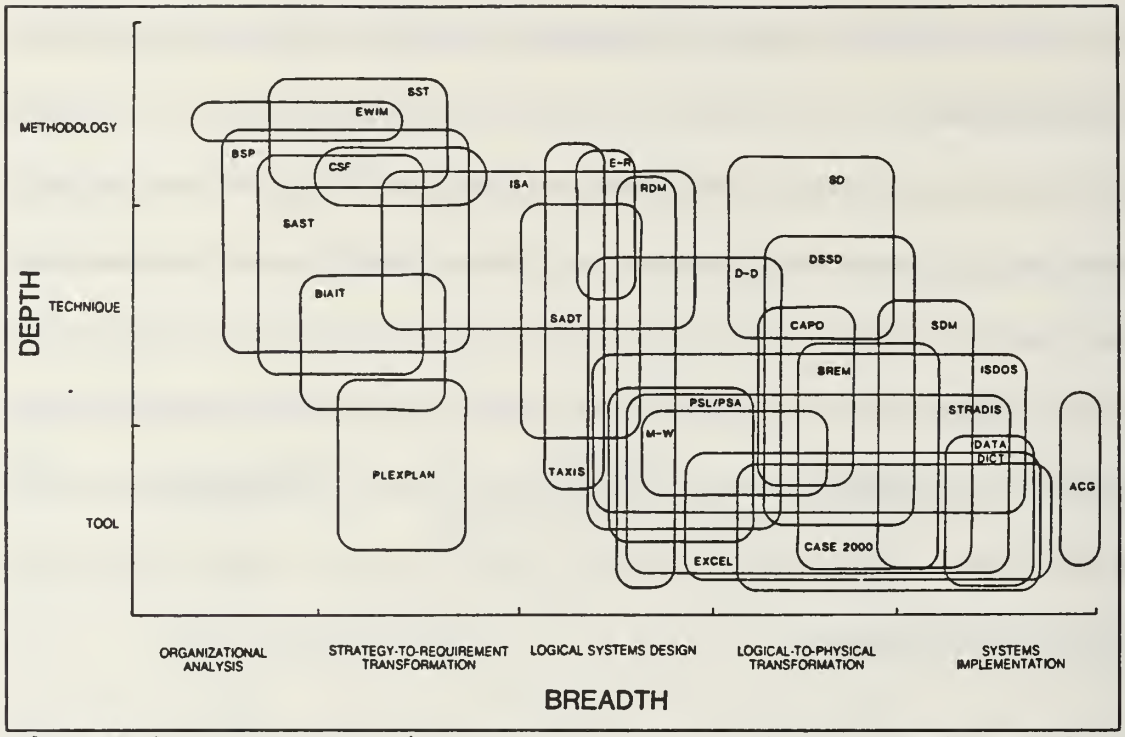

Figure 4. Comparison of IE Methods and Tools. (Hackathorn and Karimi, 1988)

methodologies in relation to their conceptual foundations and their practical results. This depth dimension consists of three levels:

- **methodology:** explains the conceptual basis for IE activities.
- **technique:** specifies the steps, including inputs and results, in performing IE activities.
- **tool:** identifies the manual or automated means of analysis of IE activities.

Figure 4 represents the extent of coverage of IE methodologies and tools, as mapped by Hackathorn and Karimi (1988). The IS planning methodologies identified both in this paper and mapped in the Hackathorn and Karimi model are identified as business systems

planning (BSP), business information analysis and integration (BIAIT), critical success factors (CSF), entity-relationship model (E-R), and strategy set transformation (SST).

Although their framework did not cover a wide range of IS planning methodologies, it did serve to provide a comparison of those information engineering methodologies and tools which are designed to translate an IS strategic plan into an IS architecture.

E. A COMPREHENSIVE FRAMEWORK FOR ANALYZING IS PLANNING METHODOLOGIES

Another framework to cover the entire process of IS planning was presented by Zviran, et al. (1989) and is depicted in Figure 5. It consists of four routes (arrows)

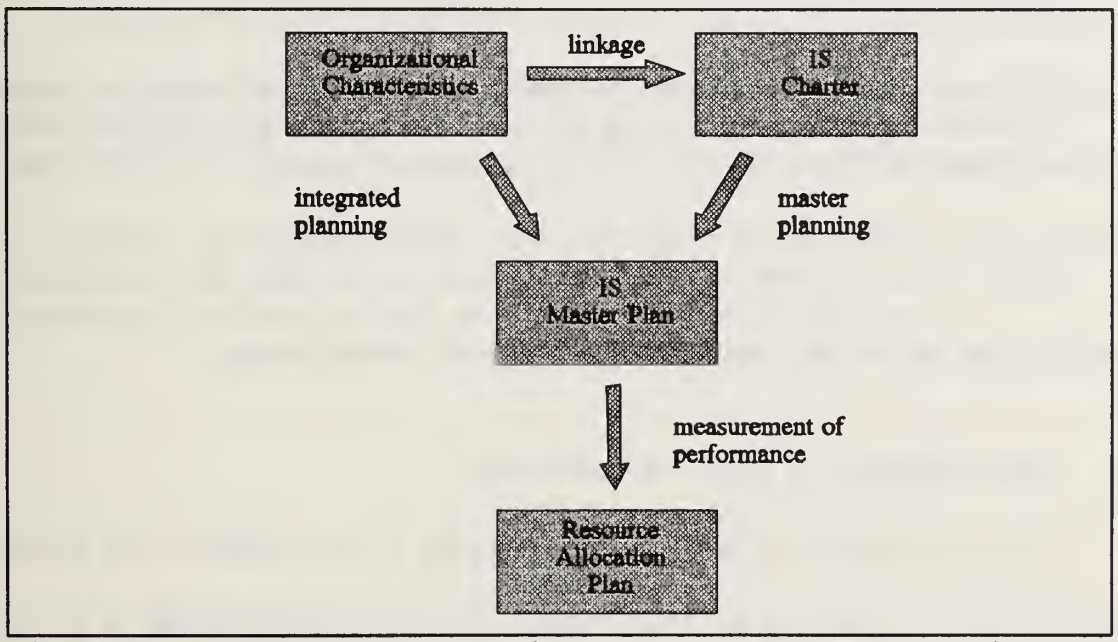

Figure 5. The Comprehensive Framework for Mapping IS Planning Methodologies. (Zviran, et al., 1989)

representing the planning processes, and four domains (boxes) that represent the end products of the planning processes. The routes establish the link between organizational

characteristics and IS characteristics, and represent the required planning activities for the transition from a source domain to a target domain. The four domains represent the inputs and outputs and the intermediate stages of the IS planning process. The planning activities represented by the routes are:

- **Linkage:** determining objectives and setting goals for the information systems, connecting an information systems plan to a business plan, and formulating an IS policy. (McLean and Soden, 1977)
- **Master Planning:** analysis of information requirements, planning of hardware and software architecture, and constructing an applications portfolio. (Ahituv and Neumann, 1990)
- **Integrated Planning:** derivation of an IS plan from the organizational characteristics, analysis of information requirements, planning of hardware and software configuration, and constructing an applications portfolio. (Miller, 1988) and (Rush, 1979)
- **Measurement of Performance:** evaluation of the anticipated results and benefits of specific applications, and setting priorities. (Dickson, et al., 1984) and (Benson and Parker, 1985)

Zviran, et al., (1989) used the four routes as a basis for classifying 28 methodologies applicable to various stages of the IS planning process.

F. THE NEED FOR A NEW FRAMEWORK

The frameworks previously described mapped a wide variety of IS planning methodologies. Bowman, et al. (1983) mapped IS planning methodologies to the three stages of IS planning. Benson, et al. (1985) also mapped IS planning methodologies to the planning relationships described in their EwIM model. Hackathorn and Karimi (1988) and others provided new frameworks for comparison but did not include the

methodologies application to the original three stages of IS planning. Zviran, et al. (1989) designed a more comprehensive framework that mapped the methodologies to the IS planning stages in more descriptive detail than provided in the three stage model.

To compare and select a suitable IS planning method from an extensive set of IS planning methodologies is not a trivial task. It would be useful to have a comprehensive framework with topics and sub-topics designed to provide generalizations about the IS planning methodologies; the coverage of the planning stages afforded by each methodology; and the advantages, limitations, and characteristics of each methodology. Such a framework would facilitate the comparison and selection of one or more methodologies that would fit an organization's requirements for IS planning.

A new framework, encompassing the main principles of the frameworks described above, will serve to provide IS planners with the means for a simplified but comprehensive comparison of the known IS planning methodologies. Such a framework will provide a better understanding of the available methodologies, their principal characteristics, and how they apply to the three stages of IS planning.

IV. A FRAMEWORK FOR COMPARISON AND SELECTION

A. COMPARISON DIMENSIONS

The proposed framework for comparison and selection of IS planning methodologies is comprised of three matrices: the concise definition matrix, the coverage matrix, and the characteristics matrix.

1. The Concise Definition Matrix

The concise definition matrix provides a brief description of each methodology through the means of a quick overview of the main theme, and the advantages and limitations of each. The concise definition matrix is an adaptation of the generic characteristics of methodologies (Zviran, et al., 1989).

The vertical axis consists of the identified IS planning methodologies. The horizontal axis consists of the main topics (listed below), the sum of which provides a concise definition of each methodology:

- **main theme:** the main thrust or focus of the methodology.
- **advantages:** notable benefits of the methodology.
- **limitations:** significant drawbacks of the methodology.

2. The Coverage Matrix

The coverage matrix provides a comprehensive overview of the coverage of the IS planning stages provided by each methodology.

The vertical axis consists of the identified IS planning methodologies. The horizontal axis incorporates the three stages of IS planning (Bowman, et al., 1983) and the generic activities of IS planning (Zviran, et al., 1989) and (Wetherbe, 1988). The IS planning activities and their related operations are listed and defined in Table 2.

3. The Characteristics Matrix

The characteristics matrix provides an IS planner with additional characteristics of the IS planning methodologies with which to compare and select a suitable methodology. The characteristics matrix is designed to address the concerns of both top management and IS personnel. The vertical axis lists the IS planning methodologies and the horizontal axis enables an analysis of each methodology according to the following characteristics:

- **Planning route:** the planning process represented by the methodology. (Linkage/master planning/integrated planning/performance measurement) (Zviran, et al., 1989)
- **Top management involvement:** the extent of top management involvement in the IS planning process. (Yes/no). (Forman, 1988), (Lederer and Mendelow, 1988) and others.
- **Focus:** the concentration of the planning process. (Data/projects/decision information/customers). (Lederer and Sethi, 1988)

TABLE 2. IS PLANNING ACTIVITIES.

IS Planning Activity	Related Operations
STRATEGIC PLANNING	
Assess organizational characteristics	Review the organizational strategic plan, identify the organizational objectives and strategy, and assess the organizational environment.
Assess IS environment	Assess the current IS capabilities, assess the current application portfolio, and evaluate the stage of IS maturity in the organization.
Identify IS strategic opportunities	Identify the role and importance of IS in the organization, and identify the applications with strategic relevance.
Set IS strategy	Set the IS objectives, set the IS mission and strategy, and set the IS charter.
ORGANIZATIONAL INFORMATION REQUIREMENTS ANALYSIS	
Determine information requirements	Define the current and projected information needs.
Assemble application portfolio	Evaluate the organizational needs, and identify relevant IS projects.
Formulate IS architecture	Identify the resources needed, and formulate the overall architecture (hardware, software, communications, facilities, etc.).
Rank projects	Rank the IS projects according to relevant criteria.
RESOURCE ALLOCATION	
Evaluate anticipated results	Assess benefits for each project.
Assign development priorities	Review the potential benefits, estimate the time needs, and develop a priority scheme for IS projects based on projected results.
Plan for resource allocation	Develop the IS plan (hardware, software, personnel and facilities), develop the annual financial plan, and develop the specific time tables for various activities.

- **Type:** the strength of the plan. (Impact/alignment/ organization/opportunity). (Parker and Benson, 1986)

- **Competitive advantage:** addresses competitive advantage. (Yes/no). (Porter and Millar, 1985)

- **Evaluation:** evaluates and reviews IS strategy. (Yes/no).

- **Academic/commercial literature:** extent of literature (Books, periodicals, business manuals or other written documentation) for further study of the methodology. (Extensive /moderate/limited).

- **Software support:** automated support for analysis or implementation of the planning process. (Yes/no) (Lederer and Sethi, 1988)

- **Documented use:** the estimate of use in business applications. (Extensive/moderate/limited).

- **Relative cost:** implementation cost, relative to other methodologies. (High/moderate/low).

- **Approach:** the direction of the planning strategy. (Top-down/bottom-up). (Ahituv and Neumann, 1990)

- **Relationships:** analyzes business and IS relationships. (Yes/no).

- **Cost-benefit:** analyzes the cost-benefit of the projects generated. (Yes/no).

- **Risk assessment:** determines the risks associated with the projects generated. (Yes/no).

- **Principal reference:** the reference cited provides the principal discription of this methodology.

B. THE COMPARISON AND SELECTION PROCESS

The comparison and selection process may be accomplished with the following steps:

- **Step 1:** Read the synopses of all methodologies to capture their characteristics.
- **Step 2:** Review the **concise definition matrix** (Table 3) to familiarize oneself with the available IS planning methodologies and the main theme, advantages, and limitations of each.
- **Step 3:** Examine the **coverage matrix** (Table 4) to determine the extent of the methodologies' coverage of the IS planning stages and the specific aspects of each stage covered.
- **Step 4**: Make tentative selection of one or more methodologies.
- **Step 5:** Study the **characteristics matrix** (Table 5) to affirm the desired characteristics of the selected methodology(s).
- **Step 6:** Review the synopsis of the selected methodology(s) and refer to the original references.

The comparison and selection framework is not designed to select a specific methodology. Rather, it will facilitate the selection process by surfacing possible choices of methodologies that may be appropriate for the organizational IS planning requirements.

C. IDENTIFIED IS PLANNING METHODOLOGIES

A comprehensive survey of IS literature identified 35 IS planning methodologies that are applicable to one or more stages of the IS planning process. Chapters V, Strategic IS Planning Methodologies; VI, Organizational Information Requirements Analysis Planning Methodologies; and VII, Resource Allocation Planning Methodologies classify the methodologies into their respective IS planning stage and provide a synopsis of each of the methodologies. The methodologies surveyed are listed below, alphabetically, within their respective planning stage.

1. Strategic IS Planning Methodologies

A total of 14 strategic IS planning methodologies were identified:

- Competitive strategy.
- Customer resource life cycle (CRLC).
- Derivation from organizational plan.
- Information engineering (IE).
- Method/1.
- Nolan stage model.
- Portfolio management.
- Reengineering.
- Strategic grid.
- Strategic fit with organizational culture.
- Strategy set transformation (SST).
- Strategic system planning (SSP).
- Strategic thrusts.
- Value chain model.

2. Organizational Information Requirements Analysis Planning Methodologies

A total of 15 organizational information requirements analysis planning methodologies were identified:

- Applications portfolio.
- Architecture planning.
- Business information planning (BIP).
- Business information systems planning (BISP).
- Business information analysis and integration technique (BIAIT).
- Business systems planning (BSP).
- Critical success factors (CSF).
- Decision Scenarios.
- Ends/means analysis.
- Entity-relationship analysis.
- Information systems master plan (ISMP).
- Information systems work and the analysis of change (ISAC).
- MIS long-range planning.
- Organizational information requirements analysis (OIRA).

3. Resource Allocation Planning Methodologies

A total of six resource allocation planning methodologies were identified:

- Chargeout.
- Eight-step process.
- Portfolio approach.
- Return-on-investment (ROI).
- Return-on-management (R-O-M)

- Zero-based budgeting (ZBB).

V. STRATEGIC IS PLANNING METHODOLOGIES

Strategic IS planning methodologies seek to link strategic organizational and IS planning. They delineate the organization's IS mission, objectives and policies and provide a framework for subsequent plans.

A. COMPETITIVE STRATEGY

Competitive strategy (Porter, 1980) is a methodology which focuses on organizational strategy, rather than on IS strategy specifically. It is an analytical framework which seeks to aide the user in understanding industries and competitors, and in formulating a competitive strategy.

Competitive strategy identifies five major competitive forces that all organizations face:

- Threat of new competitors.
- Intensity of rivalry from existing competitors.
- Pressure from substitute products.
- Bargaining power of buyers.
- Bargaining power of suppliers.

Porter contends that competitive forces determine the attractiveness of an industry. The causes of these forces, as well as how the forces change over time, can be dealt with through competitive actions. He further proposes that organizations wishing to gain

strategic advantage over their competitors should consider guiding defenses against them by formulating specific courses of competitive action that can directly influence these forces. (Porter, 1985)

A firm's relative position within its industry is a central issue in the determination of competitive strategy. Attaining and maintaining above-average performance over time is sustainable competitive advantage. The two basic types of competitive advantage, low-cost and differentiation, combined with the scope of activities, lead to the three generic activities for achieving competitive advantage: cost leadership, differentiation, and focus. Wetherbe (1988) translated Porter's generic strategies that determine competitive strategy in IS applications:

- **Be a low-cost supplier:** IS technology is utilized to reduce clerical, scheduling, inventory costs, etc.
- **Differentiate product or service:** IS technology can add features to products or services. For example, keep records for customers on all tax-deductible purchases and mail them a statement prior to income tax preparation.
- **Focus on a specialized niche:** IS technology can identify specific customers with specific needs. For example, airline frequent-flyer programs allow identification of important customers, offering them special travel packages.

Porter further subdivided focus by separating cost focus and differentiation focus. Cost focus exploits differences in cost behavior in some segments of industry, while differentiation focus exploits the special needs of buyers in certain segments.

Technology in general as well as information technology (IT) affects competitive advantage/strategy if it has a significant role in determining relative cost position or

differentiation in an organization. This is usually the case, as technology is an integral part of nearly every value activity (as defined in the value chain, a related methodology) and is involved in achieving linkages among activities. IS can have a powerful effect on both cost and differentiation. (Porter, 1985)

It has been found that an organization's IS structure often is determined by its competitive strategy. Tavakolian (1989) surveyed 52 organizations in an effort to determine such a linkage. His studies indicate that IS structure is strongly related to competitive strategy. He speculated that a conservative competitive strategy exerts pressure for the centralization of IS responsibilities, while an aggressive competitive strategy exerts pressure for the decentralization of IS responsibilities.

B. CUSTOMER RESOURCE LIFE CYCLE (CRLC)

The customer resource life cycle is an innovative framework proposed by Ives and Learmonth (1984). This methodology focuses directly on the customer, its relationship to an organization, and how a relationship can be changed or enhanced through strategic application of IS. The authors propose that proper application of this methodology will result in competitive advantage. Just as an organization's products or services go through a life cycle, the customer goes through a life cycle as well. CRLC proposes that the customer goes though thirteen fundamental stages in its relationship to a supplier, and that each of the stages should be examined to determine if IS can be used to achieve a strategic advantage. The thirteen stages are as follows:

- **Establish customer requirements:** estimating future needs for the required resources.

- **Specify customer requirements:** the customer specifies the required attributes of the resource.

- **Select a source (match customer with supplier):** the customer locates a source for the required resource. It may be an intermediary firm that affects the linkage of customer an supplier.

- **Place order:** IS may facilitate this, just as the airlines have accomplished with the placement of terminals in travel agencies.

- **Authorize and pay for goods or services:** the authorization for expenditure, and arrangement for payment, before the resource is acquired.

- **Acquire goods or services:** the customer takes receipt of the resource; the time involved with this process is usually reduced by IS.

- **Test and accept goods or services:** the customer verifies the acceptability of the resource before placement into service.

- **Integrate into and manage inventory:** the customer adds the resource to the existing inventory and manages its usage.

- **Monitor use and behavior:** the customer ensures that the resources remain acceptable.

- **Upgrade if needed:** requirements may change.

- **Maintenance:** suppliers may need to make repairs to maintain resources, as a part of the initial transaction or as just good business practice.

- **Transfer or dispose:** the end of the product resource life cycle usually does not involve the supplier.

- **Accounting of purchases:** customer monitors the how and where of resource expenditures. (Ives and Learmonth, 1984)

If an organization can assist a customer through application of IS, an organization may be able to differentiate itself from its competitors, thereby achieving competitive

advantage. This may introduce switching costs (costs that customers incur if they switch to another supplier) as well, further solidifying the customer base. By focusing on customer needs, IS is used to enhance customer service. As a firm examines its role from the CRLC viewpoint, it may discover other opportunities that will enhance its overall strategy. (Ives and Learmonth, 1984)

There is little doubt that the CRLC model helps to identify potentially important opportunities for applying IS to its competitive advantage. It does, however, fail to rank the relative importance of the IS projects or assess the efforts required to develop and implement these systems. A further disadvantage is the lack of support for the entire set of planning activities involved with implementation of effective IS. (Zviran, et al., 1989)

C. DERIVATION FROM ORGANIZATIONAL PLAN

Davis and Olson (1985) propose that IS goals, strategies, and objectives can be derived from the overall organizational plan. This relatively straightforward method for determining the IS plan consists of simply analyzing the organizational goals, strategies, and objects and determining the IS support required to achieve them. The analysis can then be organized into IS goals, objectives, and strategies. The examples in Table 3 serve to illustrate this method.

This methodology has the advantage of being uncomplicated and easy to use. Its principal disadvantages are that it is both conceptual and normative, as well as lacking in detail and implementation procedures.

TABLE 3. DERIVATION OF GOALS, STRATEGY AND OBJECTIVES

	Organizational Plan	Derivation For IS Plan
Goal	Provide high quality micro chips to the computer industry.	Provide information sales support for high quality micro chips.
Strategy	Establish quality control program for micro chips.	Establish quality control database for micro chips.
Objective	Implement teams in design/production to increase production.	Establish link between team management via telecommunication.

D. INFORMATION ENGINEERING (IE)

Information engineering is a data-oriented methodology described by Martin and Finkelstein (1982). Martin defined information engineering as:

> An interlocking set of formal techniques in which enterprise models, data models, and process models are built up in a comprehensive knowledge base and used to create and maintain data processing systems. (Martin, 1982)

IE is directed at translating the organization's strategic plan into an IS architecture that can be further translated into an organizational resource consisting of data and applications. IE is designed to merge the strengths of users, managers, and IS personnel to develop the information resources of an organization.

The methodology develops a model based on the premise that relatively unchanging data is fundamental to the organization and models its strategic objectives in terms of its data resources. The IE process is described in terms of nine basic building blocks:

- **Strategic requirements planning:** identifies the objectives of an organization and the information required to achieve them.
- **Information analysis:** determines types of data and their interrelationships.
- **Data models:** creates a logical database design.
- **Procedure formulation:** identifies events that use or change a database.
- **Data use analysis:** prepares a logical data model for conversion.
- **Distribution analysis:** converts a logical data model.
- **Physical database design:** is the result of the previous two blocks.
- **Program specification synthesis:** merges the procedures and produces application code.
- **Application development without programmers:** users develop their own applications with a non-procedural language. (Martin and Finkelstein, 1982)

IE creates flexible, objective-driven IS applications designed to meet the present and future needs of an organization. An IE designed system generates feedback allowing management to consider alternatives effectively and efficiently.

There are many competing IE methodologies and tools on the market today, Hackathorn and Karimi (1988) identified and compared 26 IE methods and tools. An example of a practical IE methodology is Texas Instruments' Information Engineering Facility (IEF), which was originally developed for the companys' own internal use. IEF seeks to understand the information needs of an organization by modeling the entire organization in terms of the data, the activities and their interrelationship. IEF is a completely software-driven IE process, a CASE tool, consisting of four integrated tool sets that do everything from planning to code generation. The planning, analysis, and

design tools are PC based; however, code generation is completed on a mainframe. IEF supports both process and data modeling through all phases. Activities, processes and process steps can be diagrammed, allowing multiple views of the organization. Users are heavily involved in the planning phase of IEF while IS personnel conduct the systems processing. IEF is a comprehensive framework for satisfying the information needs of an organization. (Texas Instruments, 1989)

IE has the advantages of being a data-oriented methodology that recognizes the importance of IS linkage to the organizational plan. The use of this methodology involves both managers and users, drawing on their organizational expertise and commitment of time to design the IS. The time involved in implementation of this methodology may be viewed by some as a disadvantage. However, without an organizational commitment of time, the benefits of IE can not be realized.

E. METHOD/1

Arthur Anderson & Company developed Method/1 in conjunction with Michael Porter (EDP Analyzer 1986). Method/1 provides a systematic, structured approach to systems development (Arthur Andersen, 1990). The methodology is designed to expose strategic uses of information and develop an IS that supports these uses. Method/1 consists of four major phases, which include information planning, custom systems design, custom systems installation, and production systems support.

The **information planning phase** aims at answering the following questions:

- What is the scope of this study, and how should it be organized?

- Where does the organization stand now?
- What is the competition doing?
- What technological opportunities are available?
- What is the organization's IS strategy? (EDP Analyzer, (1986)

The information planning phase is designed to look three to five years into the future to answer these questions. Consultants co-manage the planning team, which consists of representatives from the organization's functional areas. Two steps are taken in parallel: one examines the organization while the other examines the information system. The organizational look consists of analyzing the competitive environment of the business, to include the organization's critical success factors. At the same time other members of the planning team examine the organization's current use of IS. An assessment is made as to the quality and quantity of applications, information collected, and technology.

Upon completion of the current status assessment, opportunities in information technology are uncovered using Porter's competitive forces framework. These forces consist of rivalry of competitors, threat of new entrants, power of buyers, power of suppliers, and substitutes. A value chain analysis is then conducted on the products or services. (Porter, 1980) and (Porter, 1985) Advisors (knowledge experts) and focus groups (functional area experts) assist the planning team during this discovery phase of the process. The planning team completes this phase utilizing Porter's value analysis to study organizational activities. The purpose of this planning exercise is to identify IS that

will improve the organizational activities, uncovering strategic opportunities and thereby increasing the organization's competitive advantage. Once opportunities have been identified, the planning team creates an IS strategy to present to management. Management makes the final decisions as to which IS strategies to implement.

The **custom systems design phase** is based on the information gathered in the planning phase and covers the initial design of a custom system. Custom design has three objectives:

- Define the system.
- Estimate the installation costs.
- Give the project team the exposure and knowledge needed to successfully implement the system during the next phase (the installation phase).

The functional design is completed based on user requirements, as well as an installation plan describing the strategy for testing, converting data, training users, preparing a site and installing a system. Prototypes are developed and tested in this phase to ensure that the design specifications meet the requirements of the user.

In the **custom systems installation phase**, detailed design, coding, testing and conversion is conducted. The technical design includes the structured analysis of each application and detailed specifications for each module. The application specifications are reviewed to ensure compliance with the original specifications. The coded applications are then tested to ensure the desired performance level has been achieved. In addition to custom applications, commercial software packages are also reviewed for

integration with the system, and where required, interfaces are developed. In the controlled operation segment of this phase, the users begin using the system.

The final phase of Method/1 is **production systems support,** which begins after the intended users have accepted the system. This phase is intended to last the life of the system. Continuous monitoring and evaluation of the system helps to determine how to minimize maintenance costs and establish when modifications or upgrades are necessary. This phase provides feedback to the information planning phase.

Method/1 is a software-supported full-life-cycle methodology. Its primary advantage is its comprehensive IS planning phase which links strategic organizational goals and objectives to the IS strategy. The result is the development of a viable IS for the organization. A primary disadvantage is the potential cost of this consultant-driven commercial process.

F. NOLAN STAGE MODEL

Gibson and Nolan (1974) first proposed a four stage model that described the various stages of growth in an IS system. The stages consisted of initiation, expansion, formalization, and maturity. From this model they proposed that several aspects of managerial control could be determined: guidelines for senior managers; organizational control, management and tasks; and priorities for management attention.

In a subsequent work Nolan (1979) revised the four stage model to a six stage model. The six stages model the growth of data processing, from the introduction of the computer into the organization to mature management of data resources (refer to Figure

6). The use of the tool facilitates the diagnosis of the present state of the organization and its IS, and the many changes that are required to proceed in a controlled manner from the present stage to the next one. The six stages of the model are:

- **Stage I (initiation):** several low-level operational systems in specific functional areas are automated, such as accounting and other office administrative routines.
- **Stage II (contagion):** during this stage the organization encourages innovation, and computing applications grow. As stage II progresses, poorly designed systems begin to be maintenance problems.
- **Stage III (control):** in stage III, a shift from computer management to data resource management occurs. Usually executives are doing a bit of soul searching here, about how to best utilize the information at hand. The rebuilding of the data function and the professional improvement of the data activity, increases the stature of IS in the organization. Attempts to develop user accountability for IS expenditures are experienced, as well the growth of higher level applications, such as order entry, general ledger and material management.
- **Stage IV (integration):** Stage IV sees another infusion of new technology into the organization, and users begin to perceive increased IS support for their functions. Soon redundancy of data begins to complicate the use and control of the system. Demands grow for better control and more efficiency.
- **Stage V (data administration):** in stage V, data administration is achieved throughout the organization.
- **Stage VI (maturity):** the applications portfolio is complete. The IS structure mirrors the organization and the flow of information in the organization.

The Nolan stage model provides a framework for the determination of the stage or level of growth of an organization. This analysis of growth attainment provides the foundation for the development of an IS strategy. Nolan (1979) offers five guidelines for the management of growth:

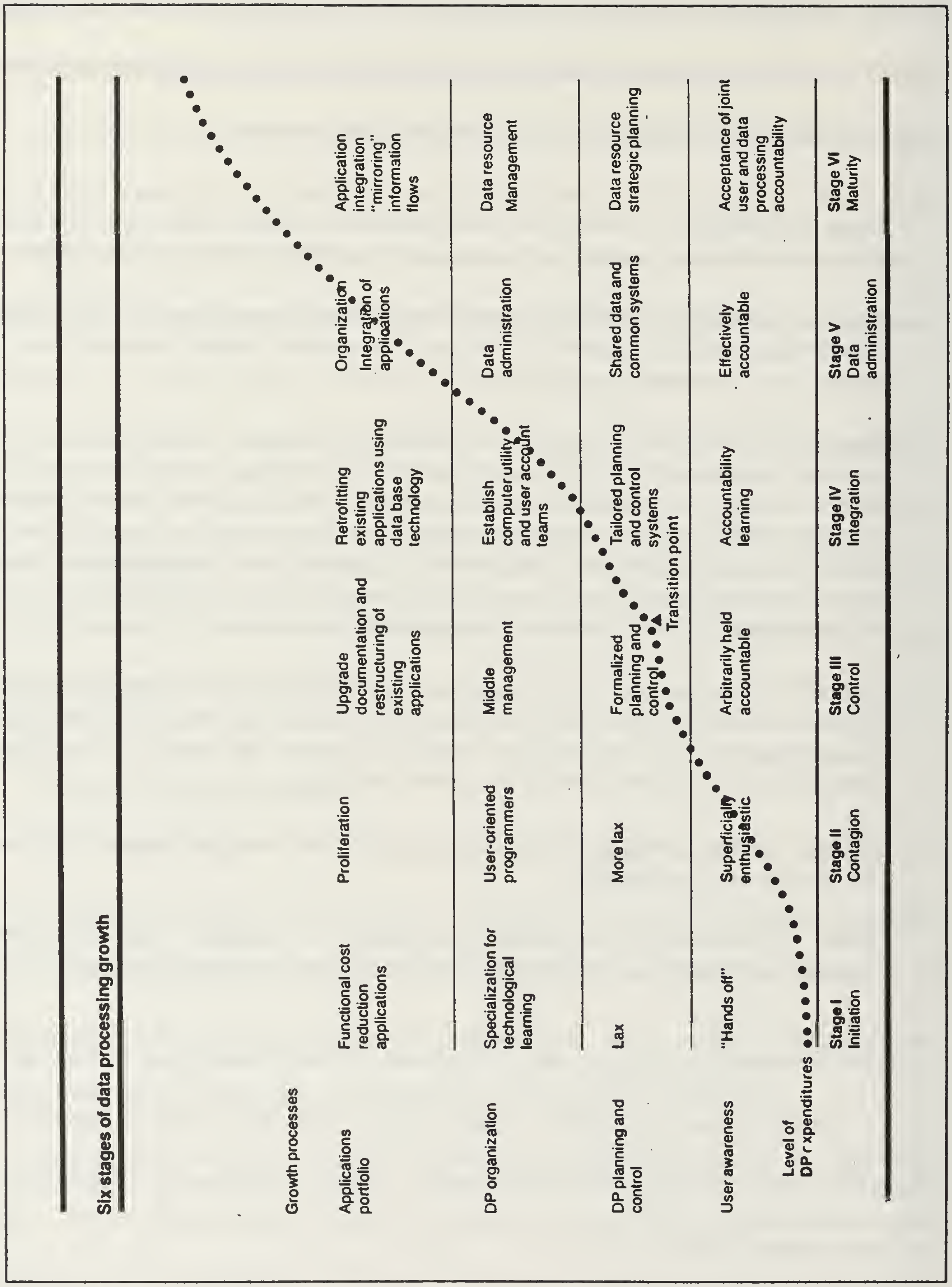

Figure 6. Nolan Stage Model. (Nolan, 1979)

- Recognize the fundamental organizational transition from computer management to data resource management.
- Recognize the importance of the enabling technologies.
- Identify the stages of the company's operating units to help keep IS activities on track.
- Develop a multilevel strategy and plan.
- Make the organizational IS steering committee work. (Nolan, 1979)

According to Nolan (1979), the development of an effective strategy and plan is a three-step process: 1) Management determines where the organization stands in the evolution of the IS functions, analyzing the strengths and weaknesses that bear on IS strategies. 2) Choose an IS strategy that fits with the organization's business strategy. 3) Outline an IS growth plan for the next three to five years, detailing this plan for each of the growth processes.

Various IS functions in an organization may not all be at the same stage of growth. This framework takes this premise into account and enables the mapping of the entire network of IS functions into one of the stages. A major failure of this multidimensional and discrete model is that it does not recognize that IS planning should be a continuous process. Some researchers, including Benbasat, et al. (1984), have discounted the stage model, arguing that the research design that resulted in Nolan's conclusions was inaccurate. Notwithstanding, the use of this model may be helpful in establishing the present state of IS in an organization and in determining the necessary changes to be implemented.

G. PORTFOLIO MANAGEMENT

Portfolio management is an informal IS planning methodology adapted from strategic business planning. (Moskowitz, 1986). This model attempts to divide an organization's IS by the business potential of the processes that they support. The systems strategies are then appropriately designed to match the applicable business strategies. This methodology focuses on three principal business strategies:

- **Product differentiation:** requires innovation in the development of IS.
- **Low-cost production and pricing:** IS must result in the enhancement of productivity and the lowering of costs.
- **Creating a market niche:** requires integration of the above IS strategies in addition to exhaustive IS support. (Moskowitz, 1986)

As with most planning methodologies, this planning process begins with a detailed analysis and understanding of the organization, its various functions, the employees of each function, and how IS will support their needs. The second step in this process is to determine an information model that describes where the information is collected, where it goes and how it eventually is to be used. This strategy may require a reconsideration of the placement of IS in an organization. Another integral element of portfolio management is the requirement that IS personnel work closely with strategic planning and marketing staffs.

While portfolio management has proven to be effective in service industries, it tends to be less effective in manufacturing industries. Some manufacturing organizations have

found, however, that information value can be built into its product though integration of such services as automated order entry or inventory control with the customer.

Porter (1985) states that one of the principal drawbacks to this methodology is that the presence of tangible or intangible interrelationships within an organization limits the use of portfolio planning models. The creation and use of interrelationships is a key strategic issue in the construction of a firm's portfolio of business, and is not something that should be obscured.

H. REENGINEERING

Michael Hammer (1990) (Prism, 1990) contends that the key to solving the systems development performance problem does not lie in further automation of the existing patterns of work. Instead, the process must be dramatically transformed. New philosophies for systems development, new techniques, and new ways for the principal parties (IS and users), to work together are need. In short, we need to "reengineer" the process of systems development.

Most traditional methodologies, Hammer writes, are designed to automate already existing, stable business processes that are limited in scope when compared to the rest of the organization. He urges the dismantling of the historical boundaries that separate the IS function from the rest of the business, and the formation of a partnership with the users:

> It is time to stop paving the cow paths. Instead of embedding outdated processes in silicon and software, we should obliterate them and start over. We should "reengineer" our businesses: use the power of modern information technology to

radically redesign our business processes in order to achieve dramatic improvements in their performance. (Hammer, 1990)

The principles of reengineering create new rules tailored to the modern environment which ultimately require a new conceptualization of the business process:

- **Organize around outcomes, not tasks:** one person should perform all the steps in a process. Design that person's job around an objective or outcome instead of a single task.

- **Have those who use the output of the process perform the process:** reengineer the processes so that the individuals who need the result of the process can do it themselves.

- **Subsume information-processing work into the real work that produces the information:** the organizational unit that produces information also should process it.

- **Treat geographically dispersed resources as though they were centralized:** use IS to get the benefits of scale and coordination while maintaining the benefits of flexibility and service.

- **Link parallel activities instead of integrating their results:** forge links between parallel functions and coordinate them while their activities are in process rather than after they are completed.

- **Put the decision point where the work is performed, and build control into the process:** the people who do the work should make the decisions; controls should be built into the process to facilitate compression of the management layers and flatten the organization.

- **Capture information once and at the source:** collect the information only one time, then store it in an on-line database for all who need it. (Hammer, 1990)

Reengineering triggers changes of many kinds, not just of the business process itself. Job designs, organizational structures, management systems, anything associated with the process must be refashioned in an integrated way. In other words, reengineering

is a tremendous effort that mandates change in many areas of the organization. The extent of these changes suggests one factor that is necessary for reengineering to succeed: executive leadership with real vision. Reengineering promotes radical change in the organization and will surely be resisted by its employees. It is confusing and disruptive and affects everything people have grown accustomed to. Only if top-level managers back the effort, and outlast the company cynics, will people take re-engineering seriously. IS offers many options for reorganizing work. But imaginations must guide the decisions about technology, not the other way around. (Hammer, 1990)

Reengineering is more a philosophy of change than a methodology for planning. It is the basis on which Hammer's company introduces its Business-Intensive Systems Development Cycle. (Prism, 1990) It is a comprehensive endeavor that ranges from a high-level redesign of the organization to installation of applications spawned by the process.

The business-intensive systems development cycle is illustrated in the following steps:

- **High-level business redesign:** top management envisions new means of conducting their business and sets goals and objectives.
- **Definition and scope:** the redesign fosters a series of project developments that are feasible to deliver in six to nine months.
- **Core team:** establish core teams, consisting of functional area experts, process designers and systems developers, to begin development of the system deliverables.
- **System design:** systems design involves a merger of IS with business processes and their associated tasks and roles.

- **Extra input:** an effort by the core team to deepen their understanding of the processes and needs, from other sources such as senior users, functional experts, and customers.

- **Software development:** design and development are simultaneous, with a prototype produced as soon as possible.

- **Pre-installation support:** when a satisfactory development pace is achieved, consideration of interfaces with existing systems begins, as well as communication with the functional areas, and users for education and training.

- **Pilot testing:** the prototypes are pilot-tested to determine the fit with the processes.

- **Installation:** if the previous steps have been properly performed, the installation is nearly complete and the new systems go into the "release mode" rather than the traditional "maintenance mode". (Prism, 1990)

A remnant of one or two core team members remains responsible for each system/application, for new releases or modifications, and for a continued fit of the system with the high-level redesign of the business. (Prism, 1990)

The business-intensive systems development cycle is a comprehensive methodology which provides a systematic approach to radical redesign of the organization. Its principal disadvantage is the resulting turmoil that may be caused with a radical redesign of an IS. Potential benefits of a reengineered IS will have to be carefully weighed against the potential for disruption of the organization.

I. STRATEGIC GRID

McFarlan and McKenney (1983) developed a unique approach for determining the strategic importance of IS in the organization. They recognized that the impact of IS on organizational strategy will vary from one organization to another. IS activities are of

strategic importance in some organizations while in others, although cost effective and useful, IS is strictly a support function. The strategic impact of IS can change over time. While IS may not be of great strategic importance today, it may be in the future; or IS may lose its present importance in future strategies. Whatever the situation, the depth and degree of IS planning will vary according to the degree of importance that IS holds in the organization.

The strategic grid defines four IS planning environments that are characterized by the degree of strategic impact of the existing IS applications portfolio, and the strategic impact of the portfolio of applications planned for development. The cells of the strategic grid (Figure 7) are defined as follows:

- **Strategic:** these organizations have a critical dependency on the smooth functioning of IT. The impact of IS in this situation dictates top management guidance in the planning effort. Total integration of IS with the organizational plan is the goal.

- **Turnaround:** these organizations also have a substantial need for IS planning. Long-term IS performance can be impacted by IS shortfalls. The impact of IS on the organization's future is sufficient to warrant significant top management involvement as well.

- **Factory:** while the smooth functioning of IS remains important, strategic goal setting for IT, with linkage to long-term organizational strategy, is not as critical in this setting. It is critically important, however, to ensure that a viable and detailed year-to-year operational plan is in place. The IS plan must still be in concert with the organizational plan in this environment.

- **Support:** in this environment IS activities are useful, though not of strategic importance to the organization. Shortfalls in IS performance will not cause significant problems. Management is much less involved. (McFarlan and McKenney, 1983)

The strategic IS grid is a diagnostic tool that is used to aide in understanding the role of IS in an organization. The relative position of IS in the grid signifies the criticality

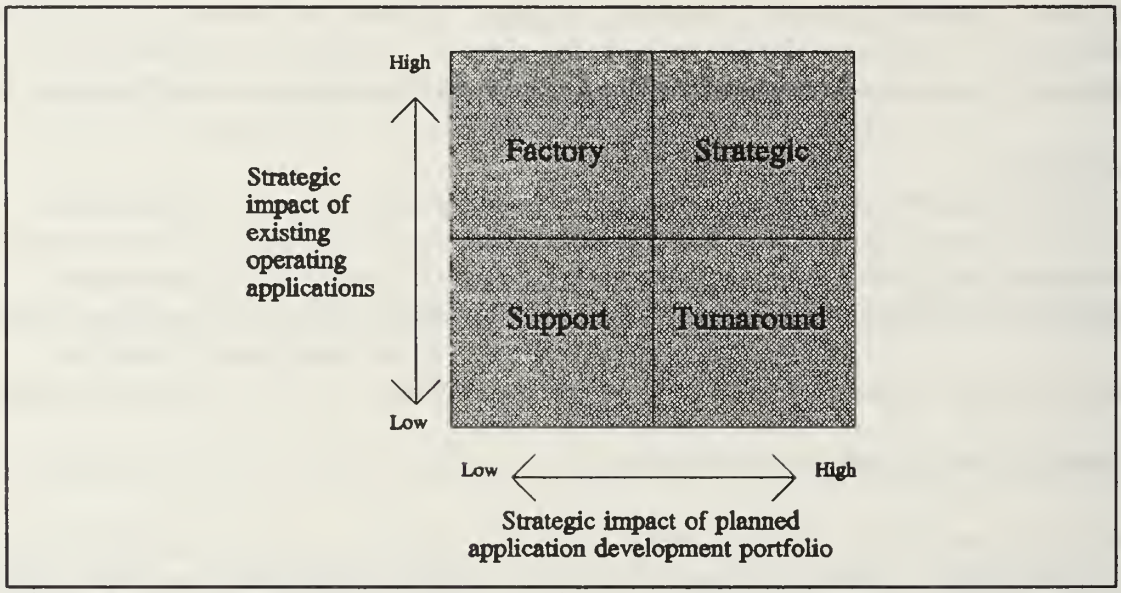

Figure 7. The Strategic Grid. (McFarlan and McKenney, 1983)

of IS to the organization, the degree of involvement required of management, and the relationship required of the IS plan and the organizational plan. (Davis and Olson, 1985)

Additional planning is needed when a firm is trying to deal with a mismatch (Cash, et al., 1988). A mismatch occurs when there is a difference between where the organization is on the grid, and where top management believes is should be. The strategic grid may also show that different organization functions are at different points on the grid; consequently the planning for one may be quite different from another.

The primary disadvantage to the strategic grid is that it explains the location of the organization, but fails to determine where the organization should go next (Davis and

Olson, 1985). This is a descriptive methodology that provides neither tools nor clear criteria for determining the location of the organization on the strategic grid (Zviran, et al., 1989).

J. STRATEGIC FIT WITH ORGANIZATIONAL CULTURE

The premise of this methodology is that every organization has its own culture of values, norms, and beliefs. Strategic fit with organizational culture provides a means to align the IS goals, objectives, and strategy with the culture to avoid resistance and risk of failure. It is essential that a match with culture be made to facilitate the smooth and successful operation of the IS. Davis and Olson (1985) offered these sources of insight into the culture of an organization:

- **Stories:** listening to stories and incidents that are repeated within an organization may indicate the organizational emphasis.
- **Meetings:** who attended and what the subject or agenda was demonstrates those things important to the organization.
- **Top management behavior:** the behavior of top management generally influences the behavior of those below them.
- **Physical layout:** the physical placement of facilities, activities or relative position of offices often are an indication of their importance.
- **Ritual:** ceremonies, banquets, and parties usually reflect organizational values.
- **Documents:** a look at organizational documents with attention paid to what has been written, to whom, and how often, will usually indicate important beliefs of the organization. (Davis and Olson, 1985)

The analysis of the information collected will serve as a basis for establishing the "rules of the game" and the classification of the rules into organizational tasks and relationships. The matching or fitting of the goals and strategies of the IS to the organizational culture is an important factor in IS planning, as it is difficult to alter or change the culture and particularly dangerous to ignore it.

The principal drawback of this methodology is that it is strictly descriptive.

K. STRATEGY SET TRANSFORMATION (SST)

King (1978) proposes an technique for determining the strategic phase of IS planning, a method he termed strategy set transformation. King views the organizational mission, objectives, strategy, and other strategic organizational attributes as an "organizational strategy set." It is this organizational strategy set that will be utilized as the basis for the determination of the "information systems strategy set." The IS strategy set is composed of:

- **System objectives:** define the purpose of the IS.
- **System constraints:** identify both internal and external constraints, such as regulations or the requirement to interface with another system.
- **System design strategies:** oriented toward the user or technical capabilities of the system, for example. (King, 1978)

Strategic IS planning is the process of transforming the organizational strategy set into the IS strategy set. The first step is the identification and interpretation of the organizational strategy set. This is accomplished by reviewing the organization's written

strategic plan. The organization may not have an organizational strategy in writing, or it may be deficient. If this is the case then King offers a process for identifying the organizational strategy:

- **Delineate the claimant structure of the organization:** identify the stake holders or those to whom the strategy must relate.
- **Identify goals for each claimant group:** the goals, objectives and strategies must be established for each claimant group.
- **Identify the organization's purposes and strategy relative to each claimant group:** the goals, objectives and strategies of the organization are related to each claimant group. (King, 1978)

Once the above process has been completed, the IS interpretation of the organizational goals, objectives and strategies should be submitted to top management for validation.

The second step is transforming the organizational strategy set into the IS strategy set. The transformation is accomplished by IS analysts who are familiar with the characteristics, configurations, and attributes of the IS. The process involves identification of the IS strategic elements for each element within the organizational strategy set. Several sets of alternatives may be produced for a final selection and approval by management. The outputs of the transformation process become the IS strategy set.

This methodology assumes that the organizational strategic plan can be adequately defined and translated into an IS strategic plan. The subjective nature of the entire process will require the close interaction of management and user with IS analysts, to ensure that the objectives and needs organization are met.

The main disadvantage of this method is that it is both conceptual and normative. (Zviran, et al., 1989)

L. STRATEGIC SYSTEMS PLANNING (SSP)

Holland's strategic systems planning methodology analyzes major functional areas of an organization to define a business function model. By combining information requirements into generic data entities and subject databases, a data architecture is obtained. The IS architecture then identifies the new systems required and a schedule for implementation. (Lederer and Sethi, 1988)

Holland's SSP is supported by its PRO Products (PROproducts, 1990) tools which are described in the following paragraphs.

PROplanner provides the tools and techniques for incorporation of the organizational and IS strategic goals and objectives. It is designed to clarify the organization's direction, forming the foundation and furnishing the models and the reports needed to complete a development plan for an IS. This tool utilizes information modeling and structured analysis techniques to provide additional detail for the project description.

PROdeveloper provides systems analysis, design and construction methods. It is designed to provide increased integration and controls the cycle of design, implementation, and redesign. PROdeveloper utilizes a structured approach to the definition of requirements and development of applications. This tool is intended to provide user-defined, organization-oriented solutions matched to the overall needs of the organization.

PROmanager is a software-driven method for project management. It is designed to provide structured techniques to help plan, organize and control projects. It provides Gantt charts, critical plan calculations, resource spreadsheets, and pre-stored work project plans. This tool produces project status reports, critical path analysis, task assignments, resource allocations, and actual-to-planned comparisons.

The PROproducts described are fully compatible, providing for the exchange of data between tools. Holland systems provides business analysts for the application of its PROproducts.

SSP provides automated storage, manipulation, and presentation of the data collected during the planning process. The software produces several reports during the process, such as "affinity" reports which show the frequencies of accesses to data, and "clustering" reports which offer guidance for database design. Functional menus guide the planner through the tasks of data collection and maintenance. A helpful interface is SSP's data dictionary which facilitates sharing SSP data with existing data dictionaries or even other automated collection tools. (Lederer and Sethi, 1988)

M. STRATEGIC THRUSTS

The strategic thrusts methodology, developed by Wiseman (1985), utilizes a grid (Figure 8) to create strategic options. This framework begins by identifying the "targets" of the application identified by Wiseman as:

- **suppliers:** those providing, material, labor, capital, etc.
- **customers:** end users or other organizations.

- **competitors:** other organizations in a similar business.

Once the targets have been identified, a determination can be made as to how the IS might be used to pursue a strategic thrust. Wiseman proposes five thrusts that can be used either offensively, if it seeks competitive advantage, or defensively, if it seeks to

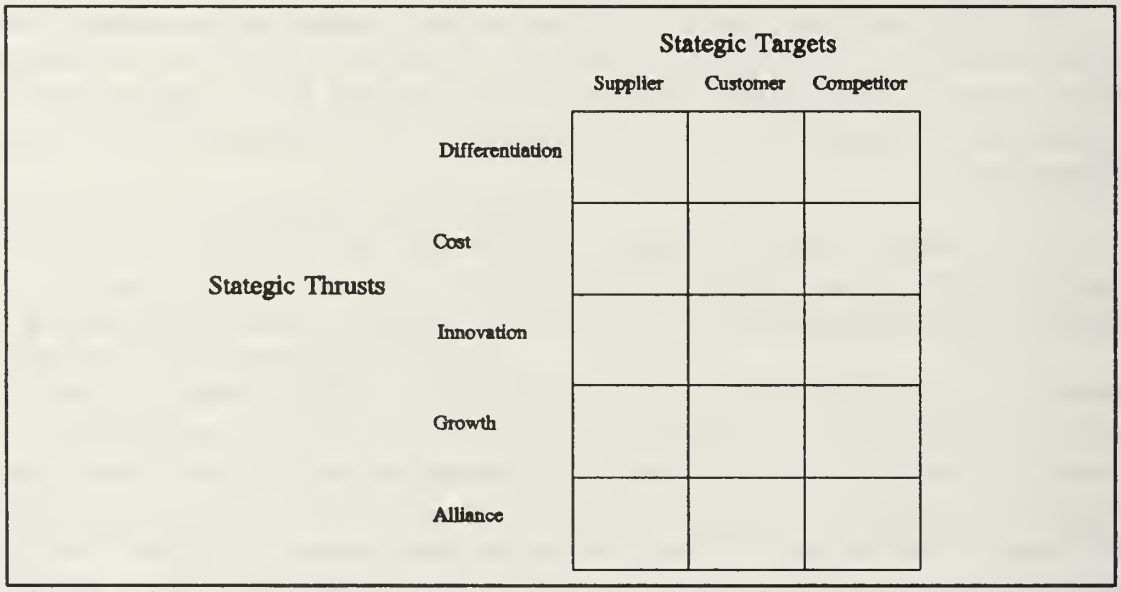

Figure 8. Framework for Identifying Strategic IS Opportunities. (Wiseman, 1985)

diminish a competitor's advantage. The strategic thrusts are:

- **Differentiation:** distinguishing one product from another, by reducing the differentiation advantage of competitors.
- **Costs:** lowering the organization's, supplier's or customer's costs or raising a competitor's.
- **Innovation:** changing the way business is conducted in the industry.
- **Growth:** gaining advantage through product-line or geographic dispersion.

- **Forming alliances:** Mergers and acquisitions of other organizations. (Wiseman, 1985)

According to Wiseman an organization may choose a combination of thrusts in the formulation of their strategy, with IS playing a key role. As can be seen by the thrusts identified above, this methodology tends to be oriented more toward the generation of external rather than internal opportunities. (Barrett and Konsynski, 1982)

The grid orients the planner to the objectives pursued by the organization in its pursuit of competitive advantage. The strategic thrusts grid comprises the interface between IS and the competitive strategy of the organization. (EDP Analyzer, 1986)

This methodology has been found to be effective in generating a significant number of objectives for IS that are worthy of implementation. (Bergeron, et al., 1990)

N. VALUE CHAIN MODEL

The value chain is a business planning concept developed by Porter (1985) and adapted to IS planning by Porter and Millar (1985). The model seeks to identify the most critical information demands of the organization.

The "value chain" highlights the role of IS in a competitive scenario. The organization's activities are separated into the discrete technological and economical activities that it performs to conduct its business. These activities are referred to "value activities." The value created by a organization is assessed by the amount that buyers are willing to pay for a product or service. The organization is profitable if the value it creates exceeds the cost of performing the value activities. To gain competitive advantage

over its competitors, the organization must either perform these activities at a lower cost or perform them in a way that leads to differentiation and more value. (Porter, 1980)

An organization's value activities are separated into nine generic activities which can be labeled either primary or support. The primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and service. The support activities involve firm infrastructure, human resource management, technology development, and procurement. Figure 9 depicts the value chain model and the relationships of the groups and activities. The planners categorize the activities that are performed within an organization in the value chain matrix. Everything that a firm does should be captured in a category. Often the placement of an activity in a specific category is a judgement call, which in itself can enlighten the planners.

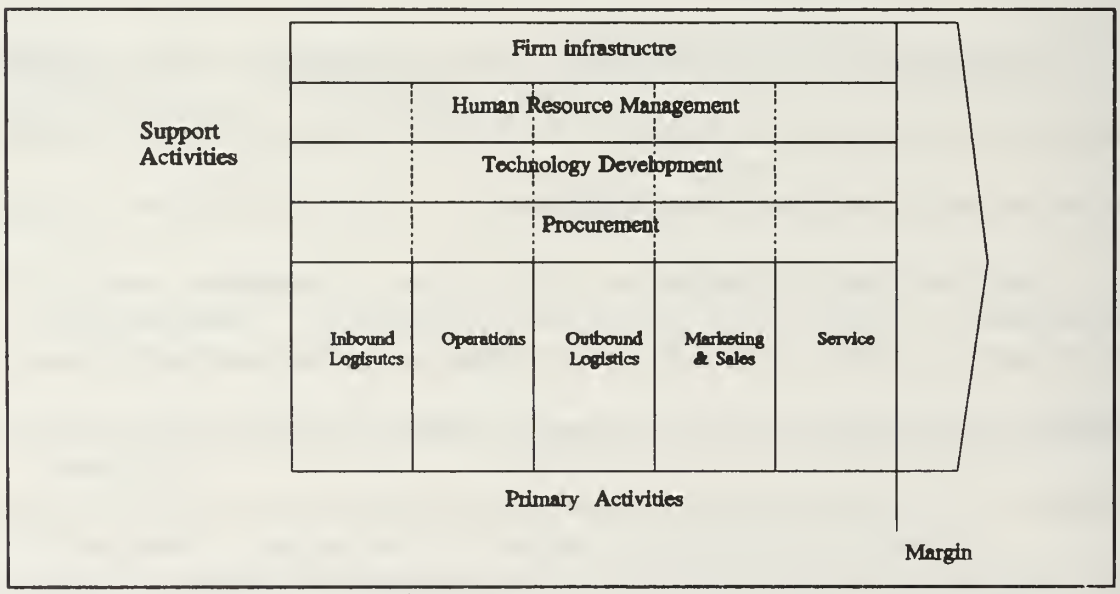

Figure 9. Value Chain Model. (Porter, 1985)

An organization's value chain is a system of interdependent activities which are interconnected by linkages with other activities. When activities are performed in such a way that factors such as cost or effectiveness are affected, a linkage has been made. The effectiveness with which linkages between activities are recognized and managed may be the source of an organization's competitive edge over its industry rivals. Linkages also occur external to the organization if the value chains of outside organizations, such as suppliers, become interdependent with the organization. Competitive advantage is achieved when these interdependencies are optimized.

Information technology pervades the value chain, causing a dramatic change in the way that activities are performed and linked to other activities. All nine value activity categories are involved in information processing in some manner. The technology which facilitates this processing is so quickly expanding the limits of what organizations can do, that managers can not exploit the opportunities. IS strategic planners utilize the value chain by estimating the potential for opportunity in each cell of the matrix, given both existing and future technologies.

The main benefit of the value chain is its support for organizational strategic applications exploration. The main disadvantages lie in its narrow focus on strategic applications and its failure to deal with other issues such as determination of IS roles and objectives. (Zviran, et al., 1989)

VI. ORGANIZATIONAL INFORMATION REQUIREMENTS ANALYSIS PLANNING METHODOLOGIES

This stage assesses the current and projected information needs to support the decision making and the operations of an organization. Information requirements analysis is designed to produce the overall information architecture for an organization or one of its functional areas. A synopsis of each of the 15 methodologies supporting this stage has been provided.

A. APPLICATIONS PORTFOLIO

The applications portfolio approach (Nolan, 1982) divides an organization into operational, tactical and strategic control levels, and further subdivides these levels into distinct functions and processes. A model of the organization is developed which draws a visual analogy between the functions and the work of the IS. Applications portfolios are then developed for each process or function at each level of control. The model is designed to paint a picture of the specific role of IS in the organization.

The design of the applications portfolio is accomplished by examining a point in time, as well as the opportunities present for cost-effective use of current computer technology, to support the identified set of organizational functions. After an inquiry as to the number of opportunities that have been tapped, the following questions are asked:

- What is the functional quality of the applications portfolio?

- What is the technical quality of the applications portfolio?

Having described the functions of an organization in a normative applications portfolio, the IS planner can use the portfolio to show how the present IS is supporting those functions. Matching all functions to the IS will provide a balance sheet for IS support. The end result of the study is a graphic output which displays immediate feedback of the opportunities for expanding IS support to functions that are critical to the organization. (Parker and Benson, 1985)

The applications portfolio methodology has many of the same advantages of the business systems planning approach, plus the added advantage of providing a detailed view of the levels of organizational control (not provided with BSP). However, like BSP this methodology is very cumbersome and all-inclusive, rather than a focused approach. (Zviran, et al., 1989)

B. ARCHITECTURE PLANNING

Architecture planning (Johnson, 1984) is a methodology that seeks to provide a means for continuous planning and is designed to align the structure and character of the IS with the needs of the organization. The process provides graphic visibility and administration to the planning process itself. The methodology begins with a definition of the existing support provided IS to the business' functional areas by means of architecture charts. It then proceeds to link the organization's goals and objectives with the IS support by means of a planning matrix.

In order to provide an understanding of how existing IS supports the organization, graphic non-technical architecture charts are developed to show the linkage of the IS to functional business areas. These charts substantiate the current or future IS needs of a functional area. The charts should be designed to be easily understood by the business functional area managers; therefore, flexibility and creativity are encouraged in their production.

Upon completion of the architecture charts a planning matrix is constructed. The vertical axis of the planning matrix consists of the users (divisions, departments, etc.). The horizontal axis consists of the planning environment, as well as:

- Existing IS support.
- Work-in-progress.
- Short-range projected needs.
- Long-range projected needs.

The above items should also be linked to the architecture charts.

Architecture planning provides an understanding of the functional areas and the IS that supports, or is needed to support them. This methodology may provide an adequate planning process for the a small or medium-sized organization's needs, but it may be too detailed for large organizations. (Johnson, 1984)

C. BUSINESS INFORMATION ANALYSIS AND INTEGRATION TECHNIQUE

This methodology was developed by IBM (Carlson, 1979), (Kerner, 1979) in the late 1970s. It employs a questionnaire, with seven questions, to define precisely the organization's information requirements and the IS required to support those requirements. The theory assumes that a normative set of information requirements may be constructed from the responses of individual managers to such a questionnaire.

In his description of BIAIT, Carlson listed and defined the ground rules for the use of the methodology:

- **Classify the order:** a formal or informal request, such as a purchase order, that requires a response from a supplier.
- **Define order entity:** a thing, space or skill.
- **View the supplier:** rather than the customer.
- **Multiple orders per supplier can occur:** bill or pay cash, is an example of two different types of orders.
- **All questions have one of two answers:** either a simple yes or no, or one of two choices. (Carlson, 1979)

The seven BIAIT questions consist of four concerning the supplier and three concerning the ordered entity. The supplier questions deal with billing, delivery, customer profile, and price, while the ordered entity questions deal with leased versus sold, tracking, and custom order versus stock. Each question is asked at three levels:

organization, department, and occupation. The result is a score that will lead to the construction of a comprehensive model of the organization's information requirements.

The BIAIT process points toward who the data owners and data users in the organization should be. The methodology attempts to elicit an agreement between end-user management and information analysts before beginning installation of the actual IS.

One of the advantages of this methodology is that it describes the information requirements in language easily understood by both top management and IS personnel, while defining the providers and owners of information. A distinct disadvantage is that this method fails to link the IS and organization plans.

D. BUSINESS INFORMATION PLANNING (BIP)

The business information planning methodology (Kerner, 1979) utilizes the business information analysis and integration technique (BIAIT) to match end users to data processing functions. This organizational analysis methodology is the successor to the business information characterization study (BICS) (Zachman, 1982).

The methodology is based on a normative, top-down model of the information needs of an organization. It relates organizational functional areas to data classes by means of accountability analysis. An information model is built on the basis of the quantity and type of orders it receives. Orders are requests made from outside the organization to which the organization must respond. The response is the product or service that the organization provides. There are management options for each type of order, such as produce, order, or stock; and whether payment will be billed, or paid in cash. After

identifying order types, a series of questions are asked to determine management options. The business functions are identified by the answers to these eight questions:

- **Payment:** do you bill the customer?
- **Delivery:** do you keep records for use in processing the order?
- **Customer profile:** do you keep records, by individual customer, for planning purposes?
- **Ownership:** do you keep title to the ordered products after delivery?
- **Tracking:** do you initiate service, change, or recall a product after it has left your organization?
- **Specification:** do you create product/service specifications?
- **Manufacture:** do you make the product or service?
- **Stock finished goods:** do you stock the ordered product? (Kerner, 1979)

If the answer to any question is "yes" then a set of data classes must be present in the organization for that type of order.

User orders are analyzed, as well as the impact of changes in the answers to order-handling questions, in order to produce data and process specifications for the organization. A determination is then made as to order types and which functional areas are accountable for the data (i.e., accountability for definition, content usage and control over access to data).

After establishing the relationships of the functional areas to the data classes, the IS planner can determined the level of IS support for the goals and objectives; the impact of applications planned and installed; and of databases planned and installed.

Although this methodology (and model) have been successfully validated in more than 20 studies all over the world (Kemer, 1979), they have the disadvantage of being incomprehensive.

E. BUSINESS INFORMATION SYSTEMS PLANNING (BISP)

The primary objective of business information systems planning (Levy, 1982) is to bridge the gap between business functions and the IS. This methodology provides top-down planning and bottom-up implementation of a plan to link the two entities. It is founded on the business systems planning (BSP) principles which develop applications based on organizational information requirements. The principal difference between BISP and BSP is that former focuses on the relationship between the IS and the organization plan, while the latter focuses on data and processes. BISP's premise is that in order to give IS planning the right direction, the applications developed must be based on all organizational activities and designed to support the organization's goals and objectives and respond to the needs and values of management.

A study group composed of five to seven managers is detailed to determine a strategic planning model consisting of external threats and opportunities, internal strengths and weakness, and management values and/or objectives. Additionally, the group identifies all organizational activities and the data that supports them. The assumptions of the study group are verified through interviews with 25 to 30 other organizational managers. The interviews elicit from each manager his/her responsibilities, goals and objectives, problems and obstacles, solutions and benefits, information sources, and why

these things are important, as well as any other information deemed necessary for the organization's requirements.

Through analysis of their study and the interviews conducted, the study group is then able to derive a prioritized list of applications that will support the goals and objectives of the organization. A long-range plan for development and implementation of the applications is produced as well.

The primary disadvantage to this methodology is that it fails to provide a structured framework for integrated planning. (Levy, 1982)

F. BUSINESS SYSTEMS PLANNING (BSP)

BSP is a highly structured approach to enterprise analysis that focuses on data, the flow of data, and the data repositories, leading to the development of an IS architecture based on the data analysis. The methodology was originally developed for its own internal use by IBM and later became a successful commercial product (IBM, 1984). BSP utilizes a top-down approach with bottom-up implementation of a process designed to translate the organization's business strategy to IS strategy. (IBM, 1984)

Because of the importance of top management involvement with the process, an assessment of top management's commitment is conducted before beginning the process. Once top management is on board with the project, a project team is selected from the organization's management, which usually includes both business and IS professionals. The project team's first tasks are to identify and set goals and objectives for the organization, and to establish the scope of the project.

Following the initial steps of preparing and starting the BSP analysis, ten additional steps are undertaken to complete the BSP process:

- **Define the business process:** the resulting output is a list of all business processes, a description of each, and the identification of key processes.
- **Define business data:** identify entities and group their data into data classes.
- **Define information architecture:** relate the business processes to the data classes.
- **Analyze current systems support:** identify the existing organizations, business processes, IS applications, and data files, to detect voids or redundancies.
- **Interview executives:** a critical aspect of the top-down approach, this step validates the work of the project team, determines the objectives, defines the problems, ascertains IS needs and calculates their value.
- **Define findings and conclusions:** analyze problems and their relationships to the business processes, establish priorities for IS support, and thereby alleviate the problems.
- **Determine architecture priorities:** development and implementation takes time, this step determines the importance of each IS initiative.
- **Review information resource management:** define the environment in which the information architecture is to be developed, implemented, and operated efficiently and effectively.
- **Develop recommendations:** assist management in their decisions regarding the follow-on activities.
- **Report results:** present the final results to top management. (IBM, 1984)

This well-documented and widely-recognized methodology recognizes and emphasizes data as a corporate resource. It involves and facilitates communication between users, business managers, and IS managers. The BSP methodology is a process of synthesis and interpretative analysis, with the following principal activities (Zviran, et al., 1989):

- Identification and clarification of organizational processes.
- Analysis and summary of the organizational process and its relation to IS requirements.
- Synthesis of the application location to meet the requirements, determine the scope of the databases, and set development priorities.

The principal advantages to BSP are its emphasis on information as a resource and the involvement of top management throughout the process. Another advantage is that BSP is a frequently-applied methodology with which IBM has considerable experience. One disadvantage is that it focuses on automating existing procedures, without consideration of reengineering. However the principal disadvantages are that the BSP process is time consuming, cumbersome, and costly. Gill (1981), in his study of the implementation of BSP at Tel Aviv University, opined that time was a serious constraint in the BSP process.

1. Information Quality Analysis (IQA)

IQA is the automated version of BSP (Vacca, 1984, 1985). Like BSP, the IQA process examines the flow of data and information use to make decisions in an organization, and attempts to identify data that is missing, inaccurate, late, incomplete, under-automated, or improperly distributed. As with BSP, the data input for the IQA process is provided by joint participation by users, management, and the IS department. However, with IQA, the analysis itself is assisted by IBM simulation software, providing for more rapid diagnosis of problem areas and allowing for faster formulation of an IS

plan that addresses both short- and long-range needs. The analysis is intended to provide, within a few weeks, the critical facts needed to improve the quality of information.

An IQA is led by an IBM IS Services team leader and staffed by IBM's customer and services personnel. The studies take five to seven weeks and produces reports on the quality of data in each functional area of the corporation, as well as recommendations for their improvement. As with BSP, group session interviews are conducted to identify user information needs and evaluate user satisfaction with existing data. From the information supplied and analyzed, the study produces statistics on how the organization view the data they use to make decisions.

Even though IQA is very similar to the BSP process, it takes considerably less time and is supported by an integrated set of applications. The software automates the data entry, database creation, data manipulation, and data analysis functions. In addition to assisting in the development of a strategic plan, the data collected can provide information for the development of applications and data architectures. (Vacca, 1984, 1985)

The advantages and disadvantages to this methodology are similar to BSP; however, the serious time constraint imposed by BSP is somewhat compressed through automation.

G. CRITICAL SUCCESS FACTORS (CSF)

In his work at MIT, Rockart (1979) determined that a problem existed with defining exactly the information needs of the chief executive. He argued that these needs could

be determined by defining an organization's "critical success factors." CSFs are the critical areas found in any organization, in which satisfactory performance must be maintained, for that organization to endure and prosper. New opportunities for the use of IS, as well as prioritization of existing IS resources, can be achieved through the analysis of an organization's CSFs.

The process of ascertaining an organization's critical success factors, or key information needs, is achieved through a series of interviews with senior managers. Depending on the complexity of the organization, the interview time needed may vary from three to six hours. The interviews are conducted in two or three separate sessions. In the first session the executives goals are recorded and possible CSFs are discussed. The relationships between the goals and the CSFs are discussed thoroughly, to ensure that the analyst understands the underlying factors. Every effort is made to eliminate redundancies or combine similar CSFs. The second session reviews the results of the first, confirms the CSFs through further clarification of the factors, and establishes measures and reports for tracking them. If necessary, a third interview is conducted to confirm measures and reports.

The critical factors that determine success will vary from industry to industry. There are four principal sources of CSFs:

- **Industry structure:** the distinctive attributes of the industry that make it unique.
- **Competitive strategy, position in industry and geographic location:** each organization determines its place in the industry and the world.

- **Environmental factors:** geo-political and other environmental changes that will vary the CSFs over time.
- **Temporal factors:** internal organizational considerations that surface occasionally, that may be considered critical, at that time, because they have fallen below a measurable point. (Rockart, 1979)

There are several advantages to the use of this methodology:

- It clearly focuses on vital organizational issues.
- It is a practical and intuitive methodology.
- It provides a link between strategic and tactical IS planning.
- It assures that critical information needs are addressed. (Shank, et al., 1985)

The primary drawback to this methodology is that it has a narrow focus on a specific activity of the integrated planning process, rather than providing a broad framework for integrated planning.

H. DECISION SCENARIOS

Decision scenarios (Rockart and Crescenzi, 1983) provides a means for managing the assumptions required for planning, by creating scenarios that combine trends and events, and considers their environmental relationships (McNurlin and Sprague, 1989). The objective of this methodology is to facilitate in the determination of the organization's information needs, including the setting of priorities for developing the IS. The scenarios help identify potential problem areas and provide flexibility in future plans.

Many variables must be taken into consideration with the development of decision

scenarios, such as the business environment, government and society, organizational personnel changes, financial status, and technology.

The IS plan and its relationship to the strategic goals of the organization are determined by the planning team. Initially the planning team examines the questions management raise as they make decisions, as well as key decision-making areas. The next stage is to develop decision scenarios and to demonstrate that the information requirements can be supplied by the planned IS. Upon completion of this stage, executives and decision makers meet in a conference to discuss the planned IS and its impact on the decision-making process. The resulting output of the conference is a decision as to the type of IS to be developed and the development priorities. (McNurlin and Sprague, 1989)

The principal advantage to this methodology is that it serves to act as a catalyst, bringing top management into the planning process to determine the priorities most suited to their requirements. A disadvantage of decision scenarios is that it fails to delve sufficiently into the details of the planning process and does not provide specific and accurate tools for implementation.

I. ENDS/MEANS ANALYSIS

Ends/means analysis was developed by Wetherbe and Davis at the MIS Research Center at the University of Minnesota. It can be used to determine information requirements at the organizational, functional, or individual manager level. (Wetherbe, 1988) (Wetherbe and Davis, 1982)

This methodology is based upon general systems theory and focuses first on the outputs (goods, services, and information) called **ends**, which are generated by each organizational process. The methodology then defines the inputs and processes termed **means**, which are used to accomplish the ends. The ends from one process is the means to some other process. One example is an inventory process that provides budget information for other processes, or a marketing process that provides products to customer processes.

Ends/means analysis is primarily concerned with the effectiveness and efficiency of generating outputs from processes. Effectiveness is the degree to which the outputs from a process fill the input criteria of the other processes. Efficiency is the amount of resources used to accomplish a given end result, compared to the minimum amount of resources actually required to accomplish the same result.

The ends/means analysis model provides two types of information, effectiveness and efficiency. Effectiveness information is based upon what constitutes output effectiveness or what feedback is needed to evaluate this effectiveness. Efficiency information is based upon what constitutes input and transformation efficiency or what feedback is needed to evaluate this efficiency.

Wetherbe (1988) gives an example of an inventory manager who specified these information requirements during an ends/means analysis:

- **Ends specification**: The outputs, or end result, of the inventory management function is an inventory kept as low as possible with an acceptable level of availability.

- **Means specification:** The inputs and processes to accomplish the ends are the following: forecasts of future needs, amounts on hand and on order, items that are obsolete or in unusable condition, safety stock policy, demand variations, cost of ordering and holding inventory, cost of items, and stockouts.

In this example the efficiency measures needed for inventory management are: the number and cost of orders placed, cost of holding inventory, and loss from disposal of obsolete or unusable inventory. Efficiency will depend on the cost to attain a given level of effectiveness. Effectiveness measures needed for inventory management in this example are the number and seriousness of stockouts. (Wetherbe, 1988)

This methodology has been used in a wide range of organizational settings with positive results. Information requirements determined by this methodology are usually more extensive than those generated using other methodologies. The problem with most information planning tools is that they usually result in an IS that provides more efficiency-oriented information than effectiveness-oriented information. While most would agree that it is more important to be effective than to be efficient, ends/means analysis brings out effectiveness information requirements as well. These requirements are typically interdepartmental, making this methodology especially useful for a database planning effort.

This method focuses on improving the organization's efficiency by means of information systems suited to its processes, but does not examine their suitability for the organization's goals.

J. ENTITY-RELATIONSHIP ANALYSIS

A theoretical methodology for construction of a data architecture, the entity-relationship (E-R) data model, was first described by Senko, et al. (1973). Later Chen (1976) created additional interest in the model. The E-R model creates a view of an organization through a data model. This model is often used to create a user data view of an organization. (Davis and Olson, 1985)

Johnson (1984) described what he termed entity-relationship analysis. An entity is anything for which data can be collected, such as a product, an employee, a department, a supplier, or a project. Parameters such as name, address, size or price are assigned to each collection of information. Each individual entity is then analyzed to determine its relationship to other entities. The relationships (such as employee belongs to department X) are then classified as one-to-one, one-to-many, many-to-one or many-to-many. Formal rules of data association are used to develop a snap-shot of the organization and its information flow. After all entities and their relationships have been defined the strategic plan can be transformed into databases and data dictionaries developed to maintain the integrity of the definitions.

Entity-relationship analysis is usually easily understood by the organization's employees, as it succeeds in providing a detailed but not overly technical view of the organization.

The principal disadvantage of this methodology is that the shear volume of data that it is necessary to collect makes it difficult to accomplish without the aid of computers to facilitate data collection and processing. Zviran, et al. (1989) noted that ERA was

considered to be very effective if used in conjunction with BSP, as it provides a complementary view of the information resource from a different perspective.

K. INFORMATION ANALYSIS

Analysis of the information required to support decision-making is the technique this methodology utilizes to determine organizational information requirements. Information analysis is at times referred to in literature as information requirements analysis and is based on both data analysis and decision analysis (Lord, 1984) (Munro, 1979). These approaches to the difficult task of determining information needs for decision-making are described below.

1. Data Analysis

Data analysis is a method for analyzing and improving the existing data flow. The two major objectives of data analysis are to determine what information the manager currently receives, and what information the manager needs but does not receive. There are four steps to analyzing data:

- Examine all information sources (reports, files, etc.) utilized by the manager.
- Determine how the manager uses each piece of information.
- Eliminate information redundancy.
- Determine unsatisfied information needs.

This method of analysis is useful for dealing with structured decisions and provides for flexibility in the resultant information flow. The disadvantage is that it

requires managers to articulate their information needs and fails to link those needs with organizational objectives.

2. Decision Analysis

Decision analysis involves the determination of the information required for managerial decision-making. Its principal objectives are the determination of responsibility for major decisions and the analysis of the model of each decision. The five steps of decision analysis are to:

- Determine major decision responsibilities.
- Determine relevant policy and organizational objectives of the major decisions.
- Define the steps taken to reach the decisions.
- Develop a model of each decision.
- Determine information flow requirements for each decision. (Lord, 1984)

One of the principal advantages of this method is that it explicitly links information needs to organizational goals and objectives and managerial decision-making. It is best used for the analysis of unstructured decisions. A disadvantage is that it may be difficult to determine the decision-making process through this method.

Munro concludes that information analysts should use either method, as the particular decision-making situation dictates (Munro, 1979). Data analysis fits best when the decision-making is well-defined, routine and repetitious, whereas decision analysis fits best in situations where the decision-making is less well understood, less routine, and not repetitive.

The overall advantages of information analysis are that top management is directly involved, communications channels between users and managers are opened, a top-down approach for implementation is used, and a data model of the entire organization is generated. The chief disadvantage is that it lacks techniques for estimating the benefits or value of information at the various stages of the process.

L. INFORMATION SYSTEMS MASTER PLAN (ISMP)

The ISMP methodology is an uncomplicated but comprehensive procedure that leads to a framework for an IS plan. ISMP is an offering of the consulting firm, Atkinson, Tremblay & Associates Inc. (Parker and Benson, 1986) This methodology consists of the following steps:

- Describe the organization as it is today, its direction, and the principal goals by a future target point.
- Describe the present state-of-the-art IS and make a reasonable estimate of what that IS will look like at the target point.
- Describe the organization's existing structure in terms of its applications, database, hardware, and software.
- Make an assessment of the organization against a baseline of four key areas: the date, formal information systems, information technology, and IS organization.
- Delineate a framework for a conceptual IS, as well as the strategies to be followed for the four key areas.
- Define the target situation in terms of the four key areas.
- Delineate an organizational plan for an integrated set of projects that will achieve the target point IS within the known constraints imposed by the organization. (Parker and Benson, 1986)

Several deliverables are generated as a result of the ISMP cycle. The deliverables are listed as follows:

- **ISMP Dictionary/Encyclopedia**: a collection of all components collected in the ISMP cycle, which serves as the source for all other deliverables.
- **ISMP Report**: the components of the Dictionary/ Encyclopedia are analyzed and documented in this report. This report serves as the official planning document.
- **ISMP Executive Summary:** a summary of the ISMP report which is provided to users and top management review and/or approval. This report is frequently used as means of communication to the IS steering committee.
- **ISMP Executive Presentation**: the essential elements of the Executive Summary. Also provides a mechanism for communication of elements of the ISMP to users and the IS department staff. (Parker and Benson, 1986)

ISMP is a comprehensive methodology, but it suffers from lack of implementation details.

M. INFORMATION SYSTEMS WORK AND THE ANALYSIS OF CHANGE (ISAC)

The ISAC approach generates specifications for information systems through analysis of the needs, problems, and ideas experienced by users. This methodology was developed by Lundeberg, et al. (1981) at the Royal Institute of Technology, Stockholm, Sweden. The ISAC methodology applies to a variety of tools to achieve the IS plan, including software engineering, relational algebra and predicate calculus. (Yadav, 1983)

ISAC consists of a number of activities that include, change analysis and analysis and design of the IS. Change analysis is the work conducted prior to IS development.

The purpose of change analysis is to identify problem areas that need improvement. The outcome of change analysis is the starting point for the development of an IS plan designed to solve the problems identified. The purpose of analysis and design is to find solutions for the problems found in the change analysis through the production of models that describe the different aspects of the IS. The models are then used as the basis for understanding the IS. (Lundeberg, et al., 1981)

The analysis and design of IS is divided into four areas, activity studies, information analysis, data systems design and equipment adaptation. The first two areas are referred to as "problem-oriented work" and the latter two areas as data-oriented work. The focus of problem-oriented work is the needs and problems of users. The users and systems analysts are brought together to produce user oriented models that describe *what* the IS will do to solve the problems and fulfill the needs of users. Data-oriented work focuses on *how* the hardware and software will fill the specified information needs of the users.

The four areas of analysis and design are described as follows:

- **Activity studies**: are designed to define the inputs and outputs of the information sets of the IS to include their relevant properties.
- **Information analysis:** describes the IS processes through analysis of the information sets to make a determination of what the IS will contain and perform.
- **Data systems design:** hardware-independent data system solutions for the IS are designed, as well as data structure and program design.
- **Equipment adaptation:** decisions are made as to the specific hardware will be utilized and then adapted to the data system design solutions. (Lundeberg, et al., 1981)

This methodology stresses direct user involvement in organizational analysis of the need for IS, and documents the outputs of each of the activities with activity graphs that build conceptual models of the organization.

The principal advantage to this methodology is the interaction of users and IS professionals in the development process with the emphasis on problem-solving and fulfillment of user needs. The principal disadvantages to ISAC are its narrow focus and that it fails to consider the strategic business plan or the organization as a whole .

N. MIS LONG-RANGE PLANNING

This long-range IS planning method (Long, 1982) encourages managers and planners to examine and consider all aspects of the IS operation. It details the steps for the development of a comprehensive long-range IS plan designed to provide for a more efficient allocation of IS resources. The definitive objective of long-range planning is to improve the communication links and cooperation among the various levels of the organization.

MIS long-range planning describes three phases in the development process which include:

- Preparation.
- Developing the process.
- Installation and maintenance.

The preparation phase involves attitudes, design, organization, education, and familiarization. Long (1982) contends that to neglect these subjects will make long-range planning unnecessarily difficult. IS planners must assess top management's understanding and acceptance of IS long-range planning, as well as their knowledge and awareness of computers and IS. However, the most important aspect of this phase is the commitment of top management to both the IS and the long-range planning process.

The development process should include:

- Resolution of basic planning issues such as the approach, level of detail, and the planning horizon.
- Gathering information from sources such as top management and key users, as well as from hardware and software vendors.
- Evaluation of the current status of the organization and its IS, as well as any planning constraints identified. Such things as organizational goals, funds, existing systems and expertise of users are considered.
- Future resource requirements are estimated and allocated to specific activities.
- All areas that affect the IS operation are identified and those areas that are critical are highlighted and presented in a planning matrix.
- Relative priorities of activities are determined as well as estimations of project costs and personnel requirements.

Throughout the process constant interaction with management, users and planning committees is emphasized until final approval of an IS plan is realized.

The implementation and maintenance phase is the culmination of the development of the long-range plan. The long-range plan is compiled, distributed and implemented.

The plan is reviewed periodically (usually on an annual basis) and revised and updated as necessary.

Long (1982) explicitly details each step of the long-range planning process in the form of work flow diagrams, providing a comprehensive method for developing the IS long-range plan. MIS long-range planning seeks to coordinate the activities of the entire organization through information processing and information flow. Outputs are represented by flow charts and detailed operating instructions.

The sheer size of this methodology will daunt the most aggressive planner at first look; however, its thoroughness will produce a comprehensive IS plan. It will prove to be a challenging and time-consuming undertaking, which is a disadvantage to this methodology. The principal disadvantage however, is that this method does not relate directly to the organization's goals and objectives.

O. ORGANIZATIONAL INFORMATION REQUIREMENTS ANALYSIS

Organizational information requirements analysis (OIRA) is a methodology (Wetherbe and Davis, 1983) for eliciting enterprise information requirements and developing a long-range information architecture. The methodology is based on a combination of three other methodologies: Business Systems Planning (BSP), Critical Success Factors (CSF), and Ends/Means Analysis.

The five phases of OIRA include:

- Defining the underlying organizational subsystems.
- Developing manager by subsystem matrix.

- Defining and evaluating information requirements for organizational subsystems.
- Defining major categories of information and mapping interview results into them.
- Developing information categories by subsystem matrix. (Wetherbe and Davis, 1983)

The information for the five phases is collected from organizational interviews. The structured interview method is utilized, using questions based on BSP, CSF, and ends/means analysis. The specific questions asked are:

1. Business systems planning (problems and decisions):

    a. What are the major problems encountered in accomplishing the purposes of this subsystem?

        (1) What are good solutions to those problems?

        (2) How can information plan a role in any of those solutions?

    b. What are the major decisions in managing this subsystem?

        (1) What improvements in information could result in better decisions?

2. Critical success factors:

    a. What are the critical success factors of this subsystem? (Most executives have four to eight.)

    b. What information is needed to insure that critical success factors are under control?

3. Ends/means analysis:

    a. What makes goods or services provided by this subsystem effective to users?

(1) What information is needed to insure that the subsystem is being effective at providing those goods or services?

b. How do you define efficiency in providing goods or services in this subsystem?

(1) What information is needed to evaluate the efficiency of this subsystem?

(Wetherbe and Davis, 1983)

The interview will result in the citing of a variety of information requirements needed by the subsystem. A separate interview is conducted for each organizational subsystem. After categorizing and mapping, the information is collected into a matrix. The matrix can then be utilized to prioritized the information categories.

By clearly defining the intersection of information and subsystems, an organization can avoid the problem of building separate, redundant information systems for different organizational subsystems. When an organization decides to improve information for one organizational subsystem, other subsystems that need such information can be taken into consideration. By doing the conceptual work first, an organization can identify information systems projects that will do the most good and lead to cohesive, integrated systems. This is far better than randomly selecting projects that will result in fragmented, piecemeal systems, which are continually being reworked or abandoned because they do not mesh with the organization's overall requirements. This means planning from the top down rather than from the bottom up. (Wetherbe and Davis, 1983)

Analysis of this methodology and its advantages reveals that it enables determination and identification of information categories, as well as an overall view and architectural planning of computer-based applications. Its disadvantage, however, is that

it does not tie information requirements to other resource requirements (e.g., hardware, systems software, communications, etc.). (Zviran, et al., 1989)

VII. RESOURCE ALLOCATION PLANNING METHODOLOGIES

Resource allocation planning is concerned with performance targets and the tasks, schedules, and budgets to achieve short-range objectives. The final products of this phase should be the IS budget and operations plans. A synopsis of each of the six resource allocation planning methodologies identified is provided.

A. CHARGEOUT

Chargeout (or chargeback) is a popular accounting method that organizations utilize for achieving control of escalating IS costs (Davis and Olson, 1985). The objective of such a system is to make users responsible for the costs of IS.

In the early stages of development of an organization's information systems the costs of IS are usually charged as overhead to the organization as a whole. Attempts to recoup the costs of IS generally take place after organization's have experienced growing IS costs. The IS department, through charges back to the customer for IS services, attempts to make the users responsible for the costs of computing. If users are not held accountable for their IS costs, they may not be conscious of the costs incurred. (Nolan, 1979)

There are two general methods of chargeout:

- A straightforward allocation of costs to the various users in an attempt to show how they are using (or abusing) the costs of computing. The user has no control over his/her costs.

- Profit or cost center accounting, in which the costs of IS services are billed to the user as the services are requested or utilized. The user can control costs by cutting back on services or selecting another source for the services. (Davis and Olson, 1985)

There are several specific alternatives for the accounting of IS costs; they include:

- **Overhead:** no chargeout, all costs are absorbed by the IS function.
- **Allocation of expense:** 100 percent of costs are allocated based on a percentage of total CPU usage by each subfunction.
- **Standard resource rates:** users are charged by type of service according to an established fixed rate schedule.
- **Standard rate per unit processed:** pre-specified charges for inputs and outputs by each subfunction.
- **Fixed price:** users pay a fixed price for a block of CPU time or for the development of a new system. (Nolan and McFarlan, 1975)

Chargeout systems that are intended to allocate costs in a decentralized system should be understandable, controllable, accountable, and customers should receive the benefits of the services paid for (Nolan, 1977).

Chargeout methods do tend cause users to be more conscious of costs, resulting in better IS planning and control. If users can choose to buy or not to buy IS services, they generally have a more positive attitude about the level of control they have over IS costs. (Nolan, 1977)

A primary advantage to chargeout methods is that it decentralizes the IS planning and control efforts to the user departments. Therefore the cost-benefit analysis of IS

services rests with the user. Chargeout methods tend to move justification for the use of IS to the department level rather than at the organization level. Chargeout methods work well if IS services are in demand, however, they provide little rational for the costs of accounting for IS, if the organization has excess IS services.

Wetherbe and Dickson (1979) noted several problems associated with chargeout methods, including the expense to maintain the accounting system, complexity of such systems to the user, inequities of charges with multi-department systems, and wasted resources when users cut back to save costs leaving IS services under-utilized.

B. EIGHT-STEP PROCESS

Deciding which IS projects are the top priority is not an easy undertaking for an organization. The eight-step process methodology (Buss, 1983) promotes interaction between top management, users, and IS managers to determine priorities for the completion of applications on the basis of their expected benefits. Several factors that affect the assignment of priorities to IS projects are financial benefits, organization objectives, intangible benefits, and technical importance.

Buss cited three common misconceptions concerning who should make the decisions when dealing with IS projects:

- **Users should decide priorities:** although users are important to the process, they should not be the sole driver of decisions.
- **Operating and IS managers should jointly define priorities:** top management must also be involved to relate the organization objectives to the priorities.

- **An IS steering committee should decide priorities:** sometimes true; however, these committees often get bogged down with financial and political issues. (Buss, 1983)

In most organizations IS management, rather than top management or users, will take the most active role in establishing IS priorities. In most instances the best IS decisions will be made by IS management working closely with all levels of the organization, within a framework of a formal planning process, such as the eight-step process. (Buss, 1983)

The "eight steps" of this methodology are as follows:

- **Step 1-get control of data processing:** establish the means to interact with users, improve databases, set new courses, etc.
- **Step 2-document systematically:** communicate and document the facts about data, processes, and projects.
- **Step 3-clarify organization objectives:** if they do not exist in writing, begin with the process of establishing them.
- **Step 4-rank against financial costs and benefits:** conduct cost/benefit analysis to establish the cost of implementing and operating the projects ranked.
- **Step 5-rank intangible benefits:** a four-part process to identify intangible benefits, determine scoring method, assign numerical values to each, and position the projects in a matrix.
- **Step 6-rank by technical importance:** a subjective assessment of investment versus technical levels.
- **Step 7-assess fit with objectives:** ensure the projects are linked to the organizational objectives.
- **Step 8-summarize priorities:** provide top management, as well as the "record," a summary of scoring methods and other variables used in the process. (Buss, 1983)

The eight-step process requires a strong commitment from top management for the allocation of resources to approved high-priority projects. The top managers should participate in setting priorities, clarifying organization objectives, and exercising judgment and decision-making in the IS arena. Users should commit themselves to an understanding of the intangible benefits and participate in setting priorities. IS managers must lead and manage the totality of the project.

This methodology provides a popular and unencumbered process for establishing priorities for IS projects. However, its disadvantage is that it focuses solely on quantitative benefits and disregards the competitive and strategic advantages of IS.

C. PORTFOLIO APPROACH

The portfolio approach (McFarlan, 1981) is a methodology for assessing project risk and managing projects. McFarlan contends that assessing risk, both separately and then as a part of the entire organization portfolio, will help managers make better decisions and ensure more successful outcomes. Through analysis of the applications portfolio, a measurement of project risk can be determined. McFarlan describes three important risk concerns that are inherent to any project:

- **Size of the project:** the higher the cost, the greater the risk.
- **Experience with the technology:** the more advanced the technology and the lower the experience level, the greater the risk (hiring outside skills reduces risk).
- **Project structure:** highly structured projects carry less risk. (McFarlan, 1981)

On the basis of these factors each project is evaluated individually then as an aggregate of the applications portfolio. The goal is to achieve a balance of the risk factors, thereby hedging the investment.

McFarlan categorizes the general methods for project management into four principal types:

- **External integration tools:** organization and communication devices that link project work teams to users.
- **Internal integration devices:** devices that ensure integration of the team as a unit.
- **Formal planning tools:** estimate the time, money and technical resources needed by the team, as well as structure the sequence of tasks.
- **Formal control mechanisms:** help managers assess progress and reveal possible discrepancies for corrective action. (McFarlan, 1981)

McFarlan suggests that the degree of structure and the technology relative to the organization influence the selection of items from the four categories. These project structures are described as follows:

- **High structure-low technology:** these low-risk and easy to manage projects are also the least common. The outputs are well designed and the system's concept and design are stable. External integration tools are important here.
- **High structure-high technology:** more complex than the previous category. Technical leadership and internal integration are the keys to success in this category.
- **Low structure-low technology:** user support and involvement is essential to these projects and are low in risk if intelligently managed. The key to success is close, aggressive management of external integration, augmented by formal planning and control tools.

- **Low structure-high technology:** complex high risk projects that require leaders experienced in both technology and communication with users. Internal integration is a must, formal planning and control tools are useful. (McFarlan, 1981)

Project managers need different styles and approaches to effectively manage the different types of projects described. The right approach is indicative of the project rather than the manager. (McFarlan, 1981)

The portfolio approach offers a strategic view, while examining quantitative benefits, making it preferable to other resource allocation tools analyzed in this chapter. However, it can not be directly related to other IS planning levels.

D. RETURN-ON-INVESTMENT (ROI)

ROI is a classic business decision-making approach, adapted to IS resource allocation planning, that is based on cost-benefit analysis and the prediction of a "return on investment." Very simply, the projects with the highest return on investment are chosen for development. For instance, a project with a 15 percent ROI is ranked over a project with 10 percent ROI. The selection process can be varied by the consideration of resource constraints, organization priorities, or other variables, as desired. (Wetherbe, 1988)

The financial benefits of this method are clear, but, serious drawbacks have been identified (Davis and Olson, 1985):

- Many benefits can not be quantified; however, the project is intuitively known to be of high priority.
- Projects based solely on ROI may not take into account such factors as risk.

- ROI considers proposed projects only, neglecting the value of existing projects.

ROI is a useful planning tool, taking into account the degree to which the costs and benefits of IS projects can be quantified. However, the costs and benefits of IS projects are inconsistent, complicated, interrelated, and extremely difficult to estimate, e.g., analysis of the ROI for IS projects is not a trivial matter.

E. RETURN-ON-MANAGEMENT (R-O-M)

Return-on-management (Strassmann, 1990) is a methodology that evaluates information systems and identifies excessive overhead costs based on the effectiveness of management. Strassmann contends that IS serves management rather than operating personnel. He maintains that information technology is not evenly distributed among workers and that we can better understand its effectiveness, by separating the managerial uses of IS from other applications.

Investment in information systems is inherently risky. The goals and objectives of an IS must be clear, supported by verifiable cases, and have measurable financial outcomes, or the goals may be ambiguous. If goals and actions derived in planning for IS become confused, misapplication of technology can occur, resulting in costly, ineffective systems. (Strassmann, 1990)

Traditionally, productivity has been measured by the outputs (such as products) of workers divided by the inputs (such as man-hours) and management has been left out of the equation. Management was considered to be an intangible and immeasurable overhead. With R-O-M, management is considered to be the essential input to

productivity. Strassmann asserts that in recent years, management costs have exceeded labor costs, particularly when the costs of the IS that support management are considered. If management is now the largest input, physical productivity measurements have become useless. In recent years IS has been justified solely on financial terms through the use of methodologies that measure capital outlay versus profit, such as return-on-investment (ROI). ROI considers the capital efficiency not management efficiency. Strassmann argues that management, not capital, is the reason for an organization's profitability.

The R-O-M (Figure 10) concept is calculated by isolating the *management value-added* of an organization and then dividing it by the company's total *management costs*. Management value-added is what remains after contributors to the organization's inputs are paid. If management value-added exceeds management costs then management is considered to be productive. The R-O-M index (Figure 10) offers another way of looking

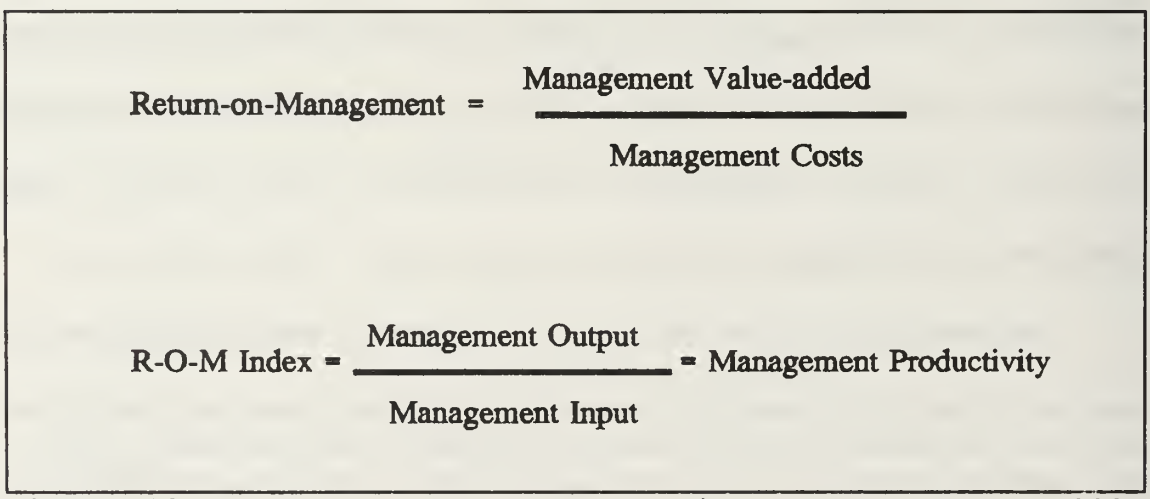

Figure 10. Return-on-Management Ratios. (Strassmann, 1990)

at the return-on-management by viewing it as a measurement of productivity. The index acknowledges how many surplus dollars you get for every dollar paid for management.

The R-O-M ratios are used to identify the productivity or value of information systems by determining how they will increase the effectiveness of management, the principal generators, distributors and users of IS. This methodology isolates the productivity of the managerial resource, and is particularly useful for measuring service organizations. (Strassmann, 1990)

F. ZERO-BASED BUDGETING (ZBB)

Zero-based budgeting is a resource allocation method that was adapted from general business planning by Wetherbe and Dickson, as an alternative to chargeout methods (Wetherbe and Dickson, 1979). ZBB scrutinizes the existing portfolio as well as the proposed portfolio. Starting from "zero," each existing and proposed IS package is added to the portfolio, prioritized by its importance to the organization. There are three basic steps to this method:

- Develop the decision packages. (Applications, projects, activities and expenditures, to be reevaluated for addition or deletion).
- Prioritize the packages.
- Allocate resources as required.

ZBB is an effective tool for trimming the organizational "fat." In reality, the organization does not start at zero, as it would be very costly to begin the process from scratch. Rather, each department takes a starting cut of 15 to 20 percent of the previous

year's budget, then identifies the supporting services it can provide for this amount. This starting point is referred to as the base increment. Each department prioritizes its projects, each with a price tag, in descending order. As the prioritized list of projects ascends the organization, the highest priority items are reviewed for appropriateness and blended with the priorities of other departments. Finally at the top of the organization a master list is developed, priorities are reviewed, and a line is drawn. Those projects above the line are funded, while those below the line are not. ZBB is an approach which examines and reallocates resources at the margin, rather than an aggregate budget cutting tool. Therefore, it is entirely possible that the aggregate organizational budget would increase with the use of this method. (Cash, et al., 1988)

Good top-down communication that distinctly disseminates the organizations objectives is extremely important in this bottom-up approach. An otherwise effective method can be jeopardized and produce the wrong results by the time the project list reaches the top decision-makers, if open communication channels are not maintained.

This method evaluates applications, activities, and expenses, in terms of costs and benefits. ZBB can be used for development and maintenance, as well as resource allocation. An evaluation of an operational system can be employed for decisions relative to the deletion or reduction of the services in the existing system.

This method is particularly useful for identifying high-benefit IS projects. Its principal disadvantage is it focuses on proposed IS projects only, rather than the entire range of an organizational applications portfolio.

VIII. COMPARING AND SELECTING IS PLANNING METHODOLOGIES

A. COMPARING IS PLANNING METHODOLOGIES.

A comprehensive IS plan is essential to the successful development and utilization of IS in organizations (Ahituv and Neumann, 1990). IS planning methodologies provide a framework to assist the planning process; however, comparing IS planning methodologies for the purpose of selecting one or more to support this process can be an overwhelming task for the IS planner.

Attempting to find a methodology to assist in the planning process may result in confusion, rather than clarity, given the large number of methodologies available. The surveyed IS planning methodologies vary greatly in scope and coverage. Subtle but often complex differences in the methodologies and differing priorities within an organization's management structure further exacerbate the problem. (Barlow, 1990)

How to select an IS planning methodology has been recognized as one of the major problems of IS planning (Bowman, et. al., 1983) (Wetherbe, 1988) (and others). The matrices presented are designed to reduce confusion and provide a clear and comprehensive framework for comparison and selection of a methodology that fits the needs of the organization.

1. Defining The Methodologies

Reading the synopses of the IS planning methodologies was the first step of the comparison and selection process. To further assist the planner in the comparison of

IS planning methodologies, a matrix consisting of the main theme of the methodology, with the principal advantages and limitations of each, is offered. The **concise definition matrix** is designed to facilitate a quick overview of the available methodologies. Reviewing the concise definition matrix is the second step of the comparison and selection process. Tables 4A, 4B, and 4C provide a listing of each of the surveyed methodologies with their concise definitions. The methodologies are listed alphabetically and have been segregated by their fit in the three stage model (Bowman, et al., 1983).

2. Determining The Coverage

The third step in the comparison and selection process is determining the extent of coverage of the methodologies. By comparing the range of coverage within the three IS planning stages, the IS planner can select of one or more methodologies to provide the type of coverage desired for the planning exercise anticipated. The coverage matrix will facilitate this process.

TABLE 4A. THE CONCISE DEFINITION MATRIX.

Strategic IS Planning Methodologies			
	Main Theme	**Advantages**	**Limitations**
Competitive Strategy	Focuses on organizational strategy through analysis of competitive forces.	Emphasis is on organizational strategy.	Focuses solely on competitive strategy.
Customer Resource Life Cycle	Analyzes the relationship of the customer and the IS strategy.	Provides a systematic process to identify IS strategic opportunities in customer relationships.	A narrow focus only on competitive advantage.
Derivation From Organizational Plan	Derives IS strategy and objectives from the organizational plan.	Illustrates IS goals and objectives derived from the organizational plan.	Both descriptive and normative. Dependant on documented organizational plan.
Information Engineering	A data-oriented CASE approach to translating the organization's strategic plan into IS architecture consisting of data and applications.	Creates flexible, objective driven IS applications linked to actual implementation of the organizational plan.	Initial cost and time investments are high but maybe less costly in the long run.
Method/1	Exposes strategic uses of information in a structured approach.	Identifies IS contributions to the organization's competitive advantage.	Costly and time intensive.
Nolan Stage Model	Determines the stage of maturity of IS in the organization.	Helpful in assessing and understanding the stage of IS maturity.	Both descriptive and normative, too narrow in scope.
Portfolio Management	Identifies organizational strategies and their linkage to IS strategy.	Supports the linkage of IS and organizational strategy and a reappraisal of the IS strategy.	Both descriptive and normative.
Reengineering	High-level business redesign and development of IS to meet strategic and competitive needs.	Promotes a rethinking (and reengineering) of the entire IS to match the redesign of the organization.	Costly and complex implementation.
Strategic Grid	Assesses the role and strategic importance of IS in the organization.	A helpful diagnostic tool for understanding the IS strategic role.	Normative and descriptive, lacks guidelines for implementation.
Strategic Fit With Organizational Culture	Develops an understanding of the culture of an organization as a basis for IS strategic planning.	Provides an understanding of the need for a linkage between organizational culture and the IS.	Strictly descriptive and normative.
Strategy Set Transformation	Conceptual guidelines for linking IS and organizational strategy.	Presents a comprehensive view of the attributes of the IS strategic plan and the link to organizational strategy.	Conceptual and normative.
Strategic Systems Planning	Analysis of business functional areas and defines the business model as a basis for determine IS architecture.	Illustrates the business model and IS architecture, facilitated by automated data collection.	Costly and time consuming to implement.
Strategic Thrusts	Identifies business targets and how IS can be used to pursue strategic thrusts to gain competitive advantage.	Effective in generating IS strategic objectives.	Narrowly focused on competitive advantage.
Value Chain Model	Evaluates and explores IS strategic opportunities utilizing an formal model.	Provides practical and useful techniques to identify new IS strategic opportunities.	Narrowly focused on competitive advantage.

TABLE 4B. THE CONCISE DEFINITION MATRIX.

Organizational Information Requirements Analysis Planning Methodologies			
	Main Theme	**Advantages**	**Limitations**
Architecture Planning	Provides basic guidelines for the development of IS applications portfolio.	Adapts IS, structure and application portfolio to the organization's needs.	Costly and time intensive, as well as difficult to implement.
Applications Portfolio	Presents a formal approach for developing the applications portfolio.	Comprehensive attempt to draw a visual analogy between the organizational function and the IS.	Descriptive, all-encompassing, not sufficiently focused.
Business Information Analysis Integration Technique	Determines information requirements via a set of 7 closed questions.	Accomplished by questionnaire, and easily performed and implemented.	Narrowly focused, not related to the IS strategic plan.
Business Information Planning	A data-oriented approach to the analysis of organizational information needs.	A top-down tailoring of data classes to specific business applications.	It is both normative and in-comprehensive.
Business Information Systems Planning	Analysis of information needs based on determination of business strategy.	Provides a practical process for identifying business objectives, strategy and information needs.	Normative, descriptive, and in-comprehensive.
Business Systems Planning	A data-oriented approach to formalization of an organization-wide IS master plan.	A comprehensive and well documented method with a valid basis for feasibility	A very costly and time consuming effort which is difficult to implement.
Critical Success Factors	Identification of key factors that contribute to the success of the organization.	A helpful diagnostic tool in analysis of the organization.	Both normative and descriptive, as well as narrowly focused.
Decision Scenarios	Determines information requirements on the basis of organizational decision-making processes.	Intimate involves senior management top management in the IS planning process.	It is descriptive and not sufficiently detailed.
Ends/Means Analysis	Utilizes the general systems theory to determine information requirements.	The focus on organizational efficiency is achieved by linking IS to the organizational processes.	It is normative and does not relate to the IS strategic plan.
Entity-Relationship Analysis	Presents a theoretical approach to the construction of the applications portfolio and data architecture.	It is comprehensive in its approach to understanding the flow of information and illustrating the data architecture.	Both normative and descriptive and difficult to implement.
Information Analysis	Analyzes information needed for decision-making.	Provides an in-depth analysis of organizational decision-making processes and relevant data needs.	Both normative and descriptive and difficult to implement.
Information Systems Master Plan	Provides guidelines for identifying organizational information needs.	Develops an IS plan based on the current organizational plan.	It is both normative and descriptive.
Information Systems Work and Analysis of Change	Determines information needs based on software engineering tools.	Useful for documenting organizational activities and matching them with information requirements.	Narrowly focused and not related to the IS strategic plan.
MIS Long-Range Planning	Provides guidelines for application of flow charted planning activities.	Provides a comprehensive framework for OIRA planning based on the organizational plan.	Does not relate to the IS strategic plan.
Organizational Information Requirements Analysis	Presents a method for formulation of the IS master plan.	Combines the techniques of BSP, CSF and Ends/Means Analysis in constructing the IS master plan.	Costly in time and money, and difficult to implement.

TABLE 4C. THE CONCISE DEFINITION MATRIX.

Resource Allocation Planning Methodologies			
	Main Theme	**Advantages**	**Limitations**
Chargeout	Allocation of resources based on cost/benefit analysis.	Justifies applications in organizational functional areas based on cost/benefit analysis.	Overly complex, high planning and execution costs.
Eight-Step Process	Determines priorities of competing applications based on their expected benefit.	Links applications portfolio priorities to the organizational plan.	Focuses solely on quantitative benefits of applications ignoring other aspects.
Portfolio Approach	Assembles and ranks applications portfolio based risk analysis and project evaluation.	Presents a systematic approach to analyzing the applications portfolio based on project contribution and risk.	Not related to higher stages of IS planning.
Return-on-Investment	Prioritizes applications based on calculation of its monetary return on investment.	Focuses on the quantitative analysis of expected benefits.	Benefits of IS applications are difficult to quantify.
Return-on-Management	Determines the value of IS based on its potential to increase the effectiveness of management.	Particularly useful for measuring service organizations	Too narrowly focused, fails to address the strategic value of IS.
Zero-Based Budgeting	Identifies high benefit applications and prioritizes them.	Allows assembly and prioritization of the applications portfolio based on maximizing benefits.	Limited capability to address the entire range of applications needed.

Table 5 is the **coverage matrix** which presents the detailed spectrum of the three stages of planning and the fit of the identified IS planning methodologies. The matrix gives graphic representation of IS planning methodologies by laying out a pattern for the coverage of each. This enables the viewer to readily see and make a comparison of the coverage and select one or more methodologies based on the desired coverage. The patterns and their representations are defined below:

- **Solid shade:** the IS planning methodology provides implicit (indicated) or specific coverage of this generic planning activity.
- **Shaded bar:** the IS planning methodology gives partial or minimal coverage of this generic planning activity.
- **Blank:** inadequate or no coverage of the this generic planning activity is provided by the IS planning methodology.

TABLE 5. THE COVERAGE MATRIX.

	IS Planning Methodologies	Strategic				Organization Information Requirements Analysis				Resource Allocation		
		Assess Organizational Characteristics	Assess IS Environment	Identify IS Strategic Opportunities	Set IS Strategy	Determine Information Requirements	Assemble Application Portfolio	Formulate IS Architecture	Rank Projects	Evaluate Anticipated Results	Assign Development Priorities	Plan for Resource Allocation
STRATEGIC	Competitive Strategy		IMPLICITLY									
	Customer Resource Life Cycle		IMPLICITLY									
	Derivation From Organizational Plan											
	Information Engineering					IMPLICITLY						
	Method/1		IMPLICITLY									
	Nolan Stage Model				IMPLICITLY							
	Portfolio Management				IMPLICITLY							
	Reengineering											
	Strategic Grid											
	Strategic Fit With Organizational Culture		IMPLICITLY		IMPLICITLY							
	Strategy Set Transformation		IMPLICITLY									
	Strategic Systems Planning											
	Strategic Thrusts											
	Value Chain				IMPLICITLY							
ORGANIZATIONAL REQUIREMENTS	Architecture Planning											
	Applications Portfolio				IMPLICITLY							
	Business Information Analysis Integration Technique						IMPLICITLY					
	Business Information Planning		IMPLICITLY	IMPLICITLY								

3. Additional Characteristics For Comparison

The study of Table 4 and Table 5 should enable the IS planner to make a tentative selection (the fourth step) of one or more methodologies. However, given the long term ramifications of the impending decision, consideration of additional characteristics (the fifth step) may be warranted. The **characteristics matrix** is provided in Table 6 below. The characteristics included in the table were selected to represent a wide range of concerns across several organization management levels.

TABLE 6. THE CHARACTERISTICS MATRIX.

IS Planning Methodologies	Characteristics														
	Planning Route	Top Management Involvement	Focus	Type	Competitive Advantage	Evaluation	Academic/ Commercial Literature	Software Support	Documented Use	Relative Cost	Approach	Relation-ships	Cost-Benefit Analysis	Risk Assessment	Principal Reference
Architecture Planning	integrated	no	projects	alignment	no	yes	limited	no	limited	moderate	bottom-up	yes	no	no	Johnson, 1984
Applications Portfolio	integrated	no	projects	alignment/ opportunity	no	yes	moderate	no	moderate	moderate	bottom-up	yes	yes	no	Nolan, 1982
Business Information Analysis Integration Technique	planning	no	data	alignment/ impact	no	yes	moderate	no	moderate	moderate	top-down	yes	no	no	Carlson, 1979
Business Information Planning	integrated	no	projects	alignment/ organization	no	yes	moderate	no	moderate	moderate	top-down	yes	no	no	Kerner, 1979
Business Information Systems Planning	integrated	no	projects	alignment/ organization	no	yes	moderate	no	moderate	moderate	top-down	yes	no	no	Levy. 1982
Business Systems Planning	integrated	yes	data	alignment	no	yes	extensive	yes	extensive	high	bottom-up	yes	no	no	IBM, 1984
Chargeout	performance measurement	no	projects	organization	no	no	extensive	no	extensive	high	bottom-up	no	yes	no	Davis & Olson, 1985
Competitive Strategy	linkage	yes	decisions	opportunity	yes	no	extensive	no	extensive	low	top-down	yes	no	no	Porter, 1980
Critical Success Factors	integrated	yes	decisions	alignment	yes	no	extensive	no	extensive	low	top-down	yes	no	no	Rockart, 1979
Customer Resource Life Cycle	linkage	yes	customer	impact	yes	no	extensive	no	extensive	low	top-down	no	no	no	Ives & Learmonth, 1984
Decision Scenarios	planning	yes	decisions	impact	no	yes	limited	no	limited	moderate	top-down	yes	no	no	McNurlin & Sprague, 1989
Derivation From Organizational Plan	linkage	yes	decisions	alignment	no	no	limited	no	limited	low	top-down	yes	no	no	Davis & Olson, 1985
Eight-Step Process	performance measurement	yes	projects	alignment	no	yes	moderate	no	moderate	moderate	bottom-up	yes	yes	no	Buss, 1983
Ends/Means Analysis	planning	no	projects	alignment	no	yes	limited	no	limited	low	bottom-up	yes	no	no	Wetherbe & Davis, 1982
Entity-Relationship Analysis	integrated	no	data	alignment	no	no	limited	no	limited	moderate	bottom-up	yes	no	no	Chen, 1976
Information Analysis	integrated	no	data/ decisions	alignment	no	no	moderate	no	limited	low	top-down	yes	no	no	Munro, 1979

B. SELECTING A METHODOLOGY

The sixth and final step of the comparison and selection process is to read again the synopses of the methodologies selected. An additional recommendation is to refer to the original reference for additional insight into the methodologies selected.

Practical guidance for selection of an IS planning methodology can be gained by the utilization of the comparison and selection framework. The intent of the framework is to simplify the difficult selection process. As one can see from the graphic representation of the coverage matrix (Table 5), there are no methodologies that cover all three stages of planning and few that completely cover one stage. However, there may be some advantage to using more than one methodology in formulation of the IS plan, in that complementary methodologies may provide overlapping coverage as well as different and useful perspectives that may be lacking with the use of only one methodology (Wetherbe, 1988).

IX. CONCLUSIONS AND RECOMMENDATIONS

The need for a framework that compares and selects IS planning methodologies for the planning stages has been noted by Bowman, et al. (1983) and later by Wetherbe (1988). Wetherbe also noted that such a framework would reduce confusion between competing methodologies and reduce the possibility of wasting organizational resources on the implementation of an inappropriate methodology.

An IS planner has a difficult task in determining how to make best use of the planning methodologies available. There is no question that there are as many variations of methods as there are methodologies. To select and then effect a methodology is only a part of the planning equation. The methodology itself will not determine the success or failure of the planning endeavor. The methodology simply provides a framework within which the planning process can take place (Moskowitz, 1986). From this brief definition of a methodology offered by Moskowitz, one could infer that any methodology would provide a starting point in the planning process. It is this author's opinion that any planning process would be better served with any methodology, rather than to proceed without a methodology.

The most important tool provided in the comparison and selection framework is the **coverage matrix** (Table 5). It will be from this table that the IS planner will derive the most benefit in the selection process. For example, an IS planner desiring to conduct a complete organizational information requirements analysis can look at Table 5 and

quickly see that there are three methodologies that provide full coverage of that stage: *business systems planning, MIS long-range planning,* and *organizational information requirements analysis.* If another IS planner desired coverage through all three stages of planning he might select (from Table 5): *strategy set transformation* for its ability to assess the organization and its environment. He could achieve a partial overlap in the identification of strategic opportunities with the selection of *strategic thrusts*, chosen for its ability to analyze all organizational information requirements, and complete the resource allocation stage with *zero-based budgeting.* As graphically illustrated on Table 5, the selected methodologies would provide comprehensive coverage of all three planning stages. Wetherbe opined that most organizations that use methodologies combine them to provide different, and useful, perspectives that may be missed when only one methodology is used (Wetherbe, 1988).

The comparison and selection framework provides considerable perspicacity on the IS planning process. The framework is not designed to do the actual selection, but rather to provide a process for examination of the methodologies, eliminating those methodologies that may not be applicable to the needs of the organization. Final selection of one or more methodologies must be made by the organization itself, based on the planning desired.

The comparison and selection process would be further facilitated by a decision support system based on the framework described in this thesis. It is recommended that a follow-on study of this process be conducted, incorporating such a system, to provide an automated means for the comparison and selection of planning methodologies.

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